

X-Y Recorders
PM8042, PM8043
PM8143, PM8033
PM8133, PM8134

Service Manual

4822 872 75306

870911

I&E

Industrial & Electro-acoustic Systems Division



**Industrial &
Electro-acoustic Systems**

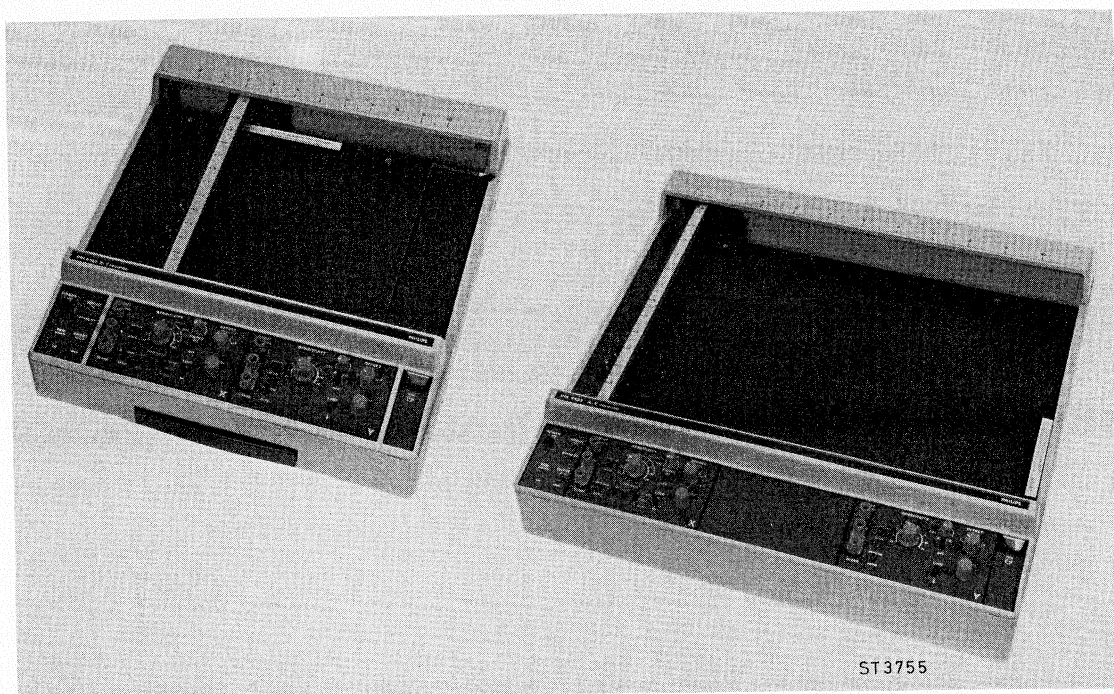
PHILIPS

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: *The design of this instrument is subject to continuous development and improvement. Therefore the instrument may not exactly comply with the information in the manual.*

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

BEMERKUNG: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

IMPORTANT

Dans votre correspondance se rapportant à cet appareil, veuillez indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

REMARQUES: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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1. TECHNICAL SPECIFICATION

1.1 GENERAL REMARKS

-Properties expressed in numerical values with stated tolerances are guaranteed by the manufacturer. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.

-The recorders type PM8042, PM8043 and PM8143 are suitable for A4 graph paper (DIN) and type PM8033, PM8133 and PM8134 are suitable for A3 graph paper (DIN). Any other difference between the various types is shown separately.

1.2 PERFORMANCE CHARACTERISTICS

Accuracy (inclusive linearity and exclusive dead band) for PM8134	<u>+0.25 % f.s.d.</u> at reference temperature <u>+0.25 % f.s.d.</u> at reference temperature and at reference range 0,05V/cm
Linearity	<u>+0.1 % f.s.d.</u>
Dead band	<u>+0.2 % f.s.d.</u>
Damping	overshoot 1% maximum
Input	floating and guarded also rear inputs impedance 1M \pm 10% source impedance \leq 10k maximum voltage 30V ac or 50V dc
Input sensitivity for PM8042	1V f.s.d. (-/21 has 10V f.s.d.) variable from 0.5V to 1.2V
for PM8043-PM8033	9 calibrated steps from 2mV/cm to 1V/cm in 1-2-5 sequence
for PM8143-PM8133- PM8134	18 calibrated steps from 0.05mV/cm to 20V/cm in 1-2-5 sequence (with decreasing variable sensitivity)
Zero suppression for all types	from -5% to + 105%
for PM8143-PM8133- PM8134	in calibrated steps 100%, 200%, 300%, 400% accuracy \pm 0.1 % /100%
Time base	provided on X axis only 0.5 sec/cm to 10sec/cm in 1-2-5 sequence accuracy \pm 3% linearity \pm 0.5%

Stray voltage rejection
(1k between + and -
guard and minus
interconnected)

	PM8043 PM8033	PM8143 PM8133 PM8134
DC CMRR	>140dB	>140dB
AC CMRR	> 70dB	> 60dB
AC SMRR	> 37dB	> 50dB

Temperature drift

for PM8042

25 μ V/ $^{\circ}$ C

for PM8143, PM8133, PM8134

0,6 μ V/ $^{\circ}$ C

for PM8033, PM8043

20 μ V/ $^{\circ}$ C

Writing speed (not for PM8134)

X axis \geq 80 cm/sec

Y axis \geq 120 cm/sec

for PM8134

X axis \geq 75 cm/sec

Y axis \geq 120 cm/sec

Acceleration

for PM8042, PM8043, PM8143

X axis 2000 cm/sec²

Y axis 5000 cm/sec²

for PM8033, PM8133

X axis 1800 cm/sec²

Y axis 5000 cm/sec²

for PM8134

X axis 1400 cm/sec²

Y1 axis 5000 cm/sec²

Y2 axis 4000 cm/sec²

Writing system

Nylon pen cartridges

PM9875R/01 (red)

and/or PM9875B/01 (blue)

Recording area

for PM8042, PM8043, PM8143

250 x 180 mm

for PM8033, PM8133, PM8134

380 x 250 mm

1.3

SAFETY CHARACTERISTICS

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety Requirements for Electronic Measuring Apparats, and has been supplied in a safe condition. This manual contains some information and warnings which must be followed by the user to ensure safe operation and to retain the apparats in a safe condition.

Insulation resistance

>500 M Ω between input terminals
and earth

Maximum common mode voltage

42V p-p ac or 60 V dc between input
terminals and earth

1.4 INITIAL CHARACTERISTICS

Dimensions

Type	PM8042 PM8043 PM8143	PM8033 PM8133 PM8134
Height (mm)	170	170
Width (mm)	360	480
Depth (mm)	410	485

Weight

PM8042 PM8043 PM8143	PM8033 PM8133	PM8134
9 kg	11 kg	12 kg

1.4.1. Environmental conditions

The environmental data mentioned in this instruction manual are based on the results of the manufacturer's checking procedures. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by NEDERLANDSE PHILIPSBEDRIJVEN B.V. SCIENTIFIC & INDUSTRIAL EQUIPMENT DIVISION, EINDHOVEN, THE NETHERLANDS.

Climatic conditions
Reference conditions

23°C + 1°
45% to 75% R.H.

Rated range of use

5°C to 40°C
20% to 80% R.H.

Storage

-40°C to +70°C
5% to 95% R.H.

1.4.2. Mechanical requirements

According to IEC 68

1.4.3. Mains supply conditions

IEC359 - S2

Mains supply voltage

100, 115, 220, 240V \pm 10%
50/60 Hz

Power consumption
for PM8134

<100 VA
<120 VA

1.4.4. Electromagnetic interference

The instruments meet the requirements of VDE-0875/K-graph.

1.4.5. Options

PM9882	Chart transport unit for PM8042, PM8043 and PM8143 (A4 size)
PM9883	Chart transport unit for PM8033 PM8133 and PM8134
PM9887/03	Rack mounting brackets for A3 size recorders
PM9887/04	Rack mounting brackets for A4 size recorders

2. CIRCUIT DESCRIPTIONS

Remarks: how to gain access to the parts see chapter 4.1.

2.1 PRE-AMPLIFIER

2.1.1. PM8042

As this recorder is a single range recorder it is not provided with a pre-amplifier.

2.1.2. PM8043-PM8033 (fig. 2 and 7)

Via the "ZERO-RECORD" switch S1 the input signal is applied to the pre-amp.

The attenuation of the "SENSITIVITY" selector is given in the table here below.

Position of selector	Attenuation
2 mV/cm	1
5 mV/cm	0.4
10 mV/cm	0.2
20 mV/cm	0.1
50 mV/cm	0.05
0.1 V/cm	0.02
0.2 V/cm	0.01
0.5 V/cm	0.004
1 V/cm	0.002

VR1 bs VR2 serve as overload protection against excessive input voltage

The noise filter consists of C1-R18, C2-R19 and C3.

With switch-potentiometer "CAL-VAR" in position "CAL" the gain of U1 (LF355) is $R20 + R21 = 12.5$.

R20

With switch "VAR-CAL" in position "VAR" the gain is increased approx. 3 times with potentiometer "VAR" turned fully clockwise.

2.1.3. PM8143-PM8133-PM8134 (fig 3 and 8)

In position V/cm of S1 the input signal is attenuated 1000x

Via the hum filter (depending on the position of S2) the input signal is applied to U1 which is a selected high performance low drift opamp U2 is a buffer amplifier (gain 10x)

Position of selector "SENSITIVITY"	Loop gain (U1 + U2)
0.05 mV/cm	500
0.1	250
0.2	125
0.5	50
1	25
2	12.5
5	5
10	2.5
20	1.25

2.2 X AND Y AMPLIFIERS (PCB'S N2 AND N3)

2.2.1. PM8042 (fig 1)

Differences in respect with all other types:

- Rear inputs only
- Input sensitivity 1V or 10V f.s.d.
- No time base provided
- CAL-VAR is a screw driver adjustment

Adjustments:

-V offset (R16)

Place switch "ZERO-RECORD" to "ZERO" and adjust the voltage between E4-E6 to zero by means of R16 preset potentiometer "OFFSET".

-CAL (R28)

Place switch "ZERO-RECORD" to "RECORD" and apply 1V to the (rear) input. Adjust the voltage between E5-E6 to 1.25V for the X system and to 0.9V for the Y system by means of preset potentiometer "CAL".

2.2.2. All other types (fig 2,3,7 and 8)

The differ because the X amp only is provided with a time base circuit, and because some resistors (or capacitors) may have a different value.

The output of the pre-amp (pcb N1) is applied to pin 5 of U1. In PM8143, PM8133 and in PM8134 one part is used as a buffer amp for the "OFFSET" signal (zero suppression signal) and the other one as a summing amp. Here the output of the pre-amp and the "OFFSET" signal are added. As in PM8043 and PM8033 no "OFFSET" is provided only one part of U1 is used. By means of S4 the output of the "LINE" mode circuit is applied to pin 6 of U1.

Time base circuit:

-The circuit consists of U2, Q4 and C3. The reference voltage is supplied by VR1 (zenervoltage from 5.9 VTO 6.5V)

-Switch S3, position "START".

The divided zener voltage (0.15V) is applied to R26. The gate voltage of Q3 is -7V then and Q3 does not conduct. The input voltage is integrated and appears at the output (point 6 of U2).

In position "HOLD" Q3 remains non-conducting however the input voltage of 0.15V is switched off so that the output voltage remains constant.

In position "RESET" the input voltage of 0.15V is applied again, however Q3 is conducting (gate voltage -7V) so that the output voltage of the integrator is reduced to 0.

2.3 X AND Y POWER AMPS AND CONTROL CIRCUIT (fig 4,9,10 and 12).

2.3.1. Description x and y power amps

These circuits are all located on pcb N4; the Y2 power amp of the PM8134 is fitted on a seperate pcb N9.

-A4 models

The X (and Y) power amp circuit is shown in fig.4 Remark: Differences between X and Y are indicated on the diagram.

-A3 models

The X amp power circuit is shown in fig.9. The Y1 amp power circuit is shown in fig.10. The Y2 amp (PM8134 only) is shown in fig.11.

The output from X and Y amps is applied to pin 3 of U1 (U101) of the power-amps via contact 2 of X1 (X101) The amplification can be adjusted by means of R4 (see full scale adjustment)

Scale limit circuit (U4)

The maximum deflections in both X and Y directions are electronically limited, so that the end stops are just not hit. In X direction the limits are adjusted by means of R31 and R34. In Y direction by means of R131-R134.

When the X carriage is moving from left to right the voltage between R8 and R9 varies from approx -0.2 to approx -6V respectively. When the voltage at pin 2 of U4 is equal to + limit control voltage at point 3, the diode CR 1 is conducting so that the voltage at pin 2 cannot exceed the + limit voltage (approx -6V) The - limit control voltage is applied to pin 5 of V4.

When CR1 is conducting (+ limit position) the pen lift solenoid is de-energised via Q10 and via RT2 (pen is raised). When CR2 is conducting (- limit position) the pen lift solenoid is controlled via CR3 and RT2 (and also raised).

With switch "SERVO" in position "STANDBY" Q9 is conducting and the amplification of U2 is reduced to zero. The gate of Q9 is zero when point H is "high". The gain of the servo amp can be adjusted by means of R43 as described below.

Overload protection circuit, Q1-Q2.

When the carriage is kept by an external force C3 (bip.elco) is charged via R15. At 7.5V transistor Q1 or Q2 is conducting, so that the base of Q3 and Q4 is coming on approx 1-2V, which means that the motor drive voltage is lowered.

Zenerdiodes VR4 and VR5 are output voltage limiters.

Measuring potentiometer buffer U5 and damping circuit.

Reference stage

-The reference voltage for the measuring potentiometer is supplied by VR3 (VR103), which is a temperature controlled zener diode, zener voltage 5.9 to 6.5V (rated value 6.2V)

-VR3 supplies also the reference voltage for the -400% OFFSET calibration.

2.3.2. The control circuit (EXT.CONTROL) fig 5 and 11

Pen control

When point 11 of X 201 (EXT.CONTROL connector) is "low", then point 6 of U 201 is "high" so that Q 208 and consequently Q 202 are conducting. C 209 is discharged. Q 212 and then Q 201 are conducting so that the pen lift solenoid is directly connected to + 12V (pen is lowered). Now C 209 is charged and after a time constant Q 212 and Q 201 will become non-conducting. The hold current is supplied via R 4.

Chart control

Via the start-stop inputs flip-flop U 203 can be set and reset. When U 203-13 is "high", transport is started. C 206 sets U 203 in "stop" position after switching on "power".

Time base

The circuit is identical to the "CHART CONTROL" circuit, as mentioned here before.

Chart plate

The supply voltage for T 201 is 11.5V and is transformed to approx 250V, by means of a voltage doubling circuit a voltage of approx 1300V is applied to the chart plate.

Control signals

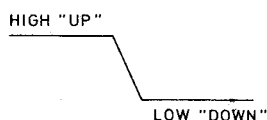
Remote control is effected by applying logic signals (TTL) to the relevant connection points of the "EXT.CONTROL" connector.

High level: + 2.7V to + 5V

Low level: 0 to + 0.4V

Pen control

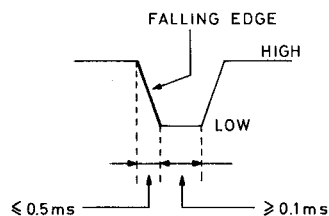
Remark: switch "PEN" in position "UP"



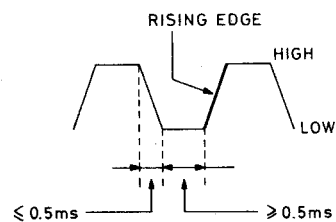
ST 3718
82 07 23

Chart transport

START-STOP



ST 3719
82 07 23



ST 3720
82 07 23

Remark: - 1 Pulse corresponds to 0.05 mm chart movement

- Maximum frequency which may be applied is 200 Hz, corresponding to a (maximum) speed of 10mm/sec.

-When an interruption of the mains supply occurs chart transport can be started again by first placing front panel toggle switch "START-STOP" to "START".

Time base

START-RESET

pulse shape identical to CHART
"START-STOP"

Remark: Switch START-HOLD-RESET must be placed to position RESET.

3. ADJUSTMENTS

3.1 OVER SCALE LIMIT ADJUSTMENT

- Set the "ZERO-RECORD" switch to ZERO.
- Turn the "ZERO ADJUSTMENT" VR over full scale.
- Adjust the limit control potentiometer so that the pen stops at approx. 2 mm over full scale.
- Potentiometer numbers and adjustment position is the following.

Y AXIS		X AXIS	
LOWER LIMIT	UPPER LIMIT	LEFT LIMIT	RIGHT LIMIT
R134	R131	R34	R31

3.2 DEAD BAND ("GAIN")

The dead band in X as well as in Y direction must be adjusted to 0.2-0.3 mm or less by means of potentiometers "GAIN".

Procedure in X direction.

- Place the "SENSITIVITY" selector to position 50mV/cm.
(not applicable for PM8042)
- Place switch "ZERO-RECORD" to position "ZERO".
- Position the recording pen to 50% f.s.d. (X and Y) by means of the respective "ZERO ADJUST" potentiometers.
- Move the X carriage manually 3mm. from its equilibrium position to the right and then let it return slowly (retard by hand)
- Lower the pen and fix this particular position by recording a vertical line (turn the Y "ZERO ADJUST" potentiometer).
- Raise the pen and move the X carriage manually 3mm. from its equilibrium position to the left and let it return slowly (retard by hand).
- Lower the pen and fix this particular position by recording again a vertical line (turn the Y "ZERO ADJUST" potentiometer).
- Adjust the distance between both vertical lines to 0.2-0.3 mm by means of the X preset potentiometer "GAIN".

Procedure in Y direction.

- Place the "SENSITIVITY" selector to position 50mV/cm.
(not applicable for PM8042).
- Place switch "ZERO-RECORD" to position "ZERO".
- Position the recording pen to 50% f.s.d. (X and Y) by means of the potentiometers "ZERO-ADJUST".
- Move the Y carriage from its equilibrium position 3mm. upward and let it return slowly (retard by hand).
- Lower the pen and fix that particular position by recording a horizontal line (turn X "ZERO ADJUST" potentiometer).
- Adjust the distance between both horizontal lines to (0.2-0.3 mm) by means of the Y "GAIN" preset potentiometer.

3.3 V OFFSET - I OFFSET

3.3.1. PM8143

I offset and V offset by means of R14 and R16 respectively.

- Connect a resistor of 100k between + and - input terminals and place the "SENSITIVITY" selector to position 0.05mV/cm.
- Place switch "ZERO-RECORD" alternately to positions "ZERO" and "RECORD" and adjust the preset potentiometer "I-ADJ" so that the pen movement is within 0.3mm.
- Place switch "ZERO-RECORD" to position "ZERO".
- Switch the "SENSITIVITY" selector alternately to positions 2 and 5mV/cm and adjust the preset-potentiometer "V-ADJ" so that the pen movement is within 0.3mm.

3.3.2. PM8043

- Sensitivity selector in position 2mV/cm.
- Adjust V-offset potentiometer (R23) so that the pen movement is within 0.3mm (Switch ZERO-RECORD alternately in both positions).

3.4 ACCURACY ("CAL")

- Connect a DC standard to the input use 1/100 attenuator for ranges from 0.05mV/cm to 5mV/cm.
- Place selector "Sensitivity" to 0.05V/cm and apply 1.25V (for A3-1.9V) and 0.9V (for A3-1.25V) to X and Y inputs respectively.
- Adjust the recording area to $250\text{mm} \pm 0.625$ (X) and $180\text{mm} \pm 0.45$ (Y) by means of potentiometer "CAL" (R4-R104) for the A4 size models and to $380\text{mm} \pm 0.95$ and $250\text{mm} \pm 0.625$ for the A3 size models.
- Check all positions of the selector.

3.5 CHECK OF THE VARIABLE RANGE ("VAR")

3.5.1. PM8143-PM8133-PM8134

Note: The figures between brackets refer to PM8133 and PM8134.
Check that the span of the selected range is increased approx 2.5 times by turning potentiometer "VAR".

- Place selector to 0.1V/cm and place the pen to zero.
- Apply 6.25V (9.5) to the X input and check that the pen can be adjusted to full scale.
- Apply 4.5V (6.25V) to the Y input and check same.

3.5.2. PM8043-PM8033

Note: The figures between brackets refer to PM8033
Check that the span of the selected range is decreased approx 2.5 times by turning potentiometer "VAR".

- Place selector to 0.2V/cm and place the pen to zero.
- Apply 2.0V (3.0) to the X input and check that the pen can be adjusted to full scale.
- Apply 1.44V (2.0) to the Y input and check same.

3.6 CHECK OF "ZERO ADJ" (-5% to + 105%)

- Place selector to 0.1V/cm and turn "ZERO ADJ" full cc.
- Apply a voltage from the standard so that the pen is positioned to zero.
- The applied voltage must be 5% f.s.d. or more. e.g. for the A4 size models 0.125V and 0.09V for X and Y respectively.
- Turn the "ZERO ADJ" fully clockwise and apply a negative voltage so that the pen is positioned to f.s.d.
The voltage must be 5% fsd.

3.7 ADJUSTMENT -400% OFFSET CAL

3.7.1. PM8143

- Place selector "SENSITIVITY" to position 0.05V/cm and the "OFFSET" selector to position 0.
- Apply 1.25V and 0.9V to X and Y inputs respectively and record the full scale deflection on the paper (100%).
- Place selector "OFFSET" to -400% and apply 6.25V and 4.5V to X and Y inputs respectively.
- Adjust by means of R23 "REF. CAL" (for Y system R123) so that the full scale deflection is within 0.5 mm of the 100% position.
- Check the other positions of the OFFSET selector according to the table here below.

OFFSET	Input voltage		Permitted deviation mm
	position 0.05V/cm	selector 0.5V/cm	
0	X 1.25 Y 0.9	12.5 9	
100	X 2.5 Y 1.8	25.0 18.	X: ± 0.875 } 0.35% Y: ± 0.63 } fsd
200	X 3.75 Y 2.7	37.5 27.0	X: ± 1.125 } +0.45% Y: ± 0.81 } fsd
300	X 5.0 Y 3.6	30.0 36.0	X: ± 1.375 } +0.55% Y: ± 0.99 } fsd
400	X 6.25 Y 4.5	62.5 45.0	X: ± 1.625 } +0.65% Y: ± 1.17 } fsd

3.7.2. PM8133-PM8134

- Place selector "SENSITIVITY" to position 0.05V/cm and the OFFSET selector to position 0.
- Apply 1.9V and 1.25V to X and Y inputs respectively and record the full scale deflection.
- Place selector OFFSET to -400% and apply 9.5V and 4.5V to X and Y inputs.
- Adjust by means of R23 "REF CAL" (for Y R123) so that the f.s.d. is within 0.5mm of the 100% position.
- Check the other positions according to the table here below.

OFFSET	Inputvoltage		Permitted deviation mm
	position 0.05V/cm	selector 0.5V/cm	
0	X 1.9 Y 1.25	19 12.5	
100	X 3.8 X 3.75	38 25	X $\underline{+1.33}$ } $\underline{+0.35\% \text{ fsd}}$ Y $\underline{+0.875}$ }
200	X 5.7 Y 3.75	57 37.5	X $\underline{+1.71}$ } $\underline{+0.45\% \text{ fsd}}$ Y $\underline{+1.125}$ }
300	X 7.6 Y 5.0	76 50	X $\underline{+2.09}$ } $\underline{+0.55\% \text{ fsd}}$ Y $\underline{+1.375}$ }
400	X 9.5 Y 6.25	95 62.5	X $\underline{+2.47}$ } $\underline{+0.65\% \text{ fsd}}$ Y $\underline{+1.625}$ }

3.8 DAMPING ADJUSTMENT ("DAMP")

X-axis damping adjustment

- Connect a low frequency oscillator to the x axis, and apply a squarewave signal. The SENSITIVITY selector should be set to the 0.1V/cm position.
- Connect a slowly increasing signal to the Y axis and adjust the DAMP ADJ control R44 so that the overshoot becomes about 2mm.
- When this adjustment cannot be performed with the DAMP ADJ control, replace the capacitance value of the C... capacitor.

Y-axis damping adjustment

- Connect the oscillator to the y axis, and apply a squarewave signal. The SENSITIVITY setting should be set to the 0.1V/cm position. Switch on the time base of the x axis, and adjust the DAMP ADJ control R144 so that the overshoot becomes about 1mm.
- When this adjustment cannot be performed with the R144 DAMP ADJ, replace the capacitance value of the C108 capacitor.

Phase adjustment

- Set the SENSITIVITY selectors of both axes to 0.1V/cm.
- Apply a 1 Hz sine signal to the input terminals of both axes to make the y-axis amplitude approx. 90% of the full scale.
- Adjust the DAMP ADJ of Y axis (R144) so that the gap between the two lines of Lissajous waveform becomes as minimum as possible.
- The gap should be 0.4 mm or less as shown below.

3.9 TIME BASE ADJUSTMENT

3.9.1. OFFSET adjustment

- Set the ZERO-RECORD switch to ZERO.
- Set the RESET-HOLD-START switch to RESET
- Set the SENSITIVITY switch to 0.5 sec/cm
- Place switch ON-OFF alternately to ON and OFF and adjust the OFFSET control (R24) so that the shift of trace becomes within 0.3mV.

3.9.2. Sweep time adjustment

- Set the sweep time range switch to 1 sec/cm.
- With the ON-OFF switch of the Time Base turned on, set the PEN UP-DOWN switch to DOWN and the START-HOLD-RESET switch to START.
- Adjust the CAL control (R15,R16) so that the sweep time is 25 or 38 sec for the full scale deflection.
- The error for the recording length of 250 mm (for A3 size 380mm) should be within 2% of full scale.

4. MECHANICAL

4.1 ACCESSIBILITY OF THE PARTS (Fig.1,2,3 and 4)

- Top cover item 1, fig.1 can be removed by loosening the 4 fixing screws item 2.
- The front panel item 3 can be hinged forward by loosening screws item 4.
- Now the frame (with chart plate) item 5 can be turned upwards by loosening screws item 6 and by partly loosening screws item 7. fig.2 shows the opened recorder.
- The input units can be taken out after loosening screws fig.3, item 1 and after loosening the connectors.
- Fig.4 shows the Y input unit with the cover taken off. Pre-amplifier and Y amplifier (no time base) can be removed now.

4.2 THE DRIVE CORDS

4.2.1. X and Y cord tensions

-X servosystem

Place the X carriage against the left hand end stop and check the cord tension according to the below mentioned table. Adjustment is possible by means of the (hexagonal) cord tension adjusting screw in the cord tensioner fig.5 and fig.6.

-Y servosystem

Place the Y carriage against the upper end stop and check the cord tension according to the below mentioned table. Adjustment is possible by sliding the guide pulley inwards or outwards (partly loosen the fixing screw, see fig.8 and fig.9).

Type (size)		Tension in grams (measure in centre)	Lateral deviation (mm)
A4	X	170 ± 20	8
	Y	30 ± 5	2
A3	X	130 ± 10	6
	Y	20 ± 2	2

4.2.2. Fitting a new drive cord

-X drive cords

Fig.10 and 11 show how the drive cord is fitted in the A4 size models and in the A3 size models respectively.

-Y drive cords

From fig.12 it can be taken how the Y drive cord is fitted.

4.3 THE X MEASURING CARRIAGE (fig.13)

It consists of a part item 1 which carries the Y system (motor, solenoid, Y arm, X sliding contact, 4 ball bearings) and an adjusting part item 2 carrying two ball bearings only. The PM8134 carriage has a third part which carries the Y 2 system. By means of the adjusting part the play between carriage (ball bearings) and guide shaft can be reduced to a minimum. First loosen partly the 3 fixing screws item 3 and then turn both adjusting screws item 4.

4.4 BACKLASH MOTORPINION - NYLON GEAR (fig.15)

Motorpinion and the nylon gear on the cord drum should engage with a small play. In case there is some eccentricity then some play should be felt in the narrowest engagement. Adjustment is possible by repositioning the servomotor after having loosened partly the motor fixing screws.

4.5 CORRECT POSITION OF THE CHART PLATE (fig.16 and 17)

-Position a sheet of graph paper on the chart plate (horizontal line over both pin point lamps) and draw a horizontal line on the sheet by moving the pen from the centre to left and right. The maximum permitted deviation with respect to a graduation line is 0.5mm.

-If the deviation is more than 0.5mm the chart plate must be repositioned. Therefore first loosen the 4 fixing screws and then adjust by means of both hexagonal set screws, item 1. (see fig.17)

5 PARTS LIST PM8042 - PM8043 - PM8143 - PM8033 - PM8133 - PM8134

5.1. MAINS - FRAME

Service code	Description								
5322 146 50195	Mains transformer, all types, except PM8134								
5322 146 40331	Mains transformer PM8134								
5322 157 51601	Mains filter								
5322 321 30278	Mains cord								
5322 276 11078	Mains switch (without knob)								
5322 414 20194	Knob								
5322 256 30223	Fuse holder								
5322 256 51001	Cap for fuse holder								
4822 253 30021	Fuse 1A - 220D								
4822 253 30025	Fuse 2A - 110D								
4822 253 30023	Fuse 1.5A - 220V D								
4822 253 30027	Fuse 3A - 110V D								
4822 253 30028	Fuse 4A D - 110V D								
4822 253 30025	Fuse 2A D - 220V								
	<table> <tr> <td></td><td>A4 size models</td></tr> <tr> <td></td><td>PM8033 (delivered 1.4A)</td></tr> <tr> <td></td><td>PM8133 (delivered 3.15A)</td></tr> <tr> <td></td><td>PM8134</td></tr> </table>		A4 size models		PM8033 (delivered 1.4A)		PM8133 (delivered 3.15A)		PM8134
	A4 size models								
	PM8033 (delivered 1.4A)								
	PM8133 (delivered 3.15A)								
	PM8134								
5322 462 40581	Rubber foot								
5322 447 90302	Cover for chart tray								
5322 447 90301	Cover for pen case								
5322 447 90626	Dust cover A3 (foldable)								
5322 447 90625	Dust cover A4 (foldable)								

5.2. FRONT CONTROLS

5322 273 30289	Selector PM8043 - PM8033	} "SENSITIVITY"
5322 273 80257	Selector PM8143 - PM8133 - PM8134	
5322 414 30038	Knob	
5322 414 70017	Insert with line	
5322 273 30287	Selector	} "OFFSET" (PM8143, PM8133, PM8134)
5322 414 30039	Knob	
5322 414 70017	Insert	
5322 277 10689	Toggle switch	{ ZERO-RECORD TIME BASE ON-OFF FILTER ON-OFF mV/cm - V/cm
5322 277 10691	Toggle switch "START-HOLD-RESET"	
5322 277 10692	Toggle switch "LINE"	
5322 277 24031	Slide switch "50 Hz - 60 Hz"	
5322 277 10688	Toggle switch	{ CHART Hold-free SERVO on-standby PEN down-up
5322 276 11078	Pushbutton switch "POWER on-off"	

Service code	Description
5322 101 40106	Switch Potm. "CAL-VAR" (2k) PM8042, 8043, 8143, PM8033
5322 414 30041	Knob
5322 414 70016	Insert
5322 101 20684	Potentiometer "ZERO ADJ" (R12 - 2k - 20% - 0.1 W)
5322 414 30037	Knob
5322 414 70015	Insert
5322 414 30042	Input connection terminal
5322 101 20685	Switch Potm. "CAL-VAR" (20k) PM8133-8134
5322 101 40118	Switch Potm. CAL-VAR (10k) PM8042

5.3. P.C.B.'S

5322 216 91667	N1 pre-amp. PM8043-PM8033
5322 216 91635	N1 pre-amp. PM8143
5322 216 91665	N1 pre-amp. PM8133 - PM8134
5322 216 91668	N2 X-amp. } PM8043
5322 216 91669	N3 Y-amp. }
5322 216 91638	N2 X-amp. } PM8143
5322 216 91639	N3 Y-amp. }
5322 216 91675	N2 X-amp. } PM8033
5322 216 91676	N3 Y-amp. }
5322 216 91671	N2 X-amp. } PM8133 - PM8134
5322 216 91672	N3 Y-amp. }
5322 216 91696	N9 Y2-amp. }
5322 216 91753	X amp. } PM8042 (1V f.s.d.)
5322 216 91754	Y amp. }
5322 694 74041	X amp. } PM8042 (10V f.s.d.)
5322 694 74042	Y amp. }
5322 216 91666	N5 switch unit - all types
5322 216 91673	N7 LED p.c.b. for chart plate - all types
5322 216 91674	N6 connector p.c.b. on X carriage - PM8043 - PM8143
5322 216 91689	N8 joint p.c.b. } PM8033 - PM8133 - PM8134
5322 321 20654	Flat cable 10p }

5.4. MEASURING POTENTIOMETERS (fig. 20)

5322 105 10495	Measuring potentiometer X axis	} A4 size
5322 105 10494	Measuring potentiometer Y axis	
5322 105 10497	Measuring potentiometer (15k) X axis	} A3 size
5322 105 10496	Measuring potentiometer (5k) Y axis	
5322 278 80179	Sliding contact (X and Y, all types)	

5.5. CARRIAGE DRIVE

5.5.1. X-System (fig. 14)

Service code	Description
5322 361 20384	Servomotor
5322 522 31672	Pinion
5322 522 20295	Gear with drum
5322 535 80686	Shaft
5322 520 20353	Bearing
	} Cord drum
5322 528 80922	Cord guide pulley
5322 321 30275	Cord – A4
5322 321 30277	Cord – A3
5322 466 81387	Base for Y motor and solenoid
5322 520 10514	Base for ball bearings
5322 520 20354	Ball bearings
	} carriage complete not for PM8134
5322 446 81407	Base for Y1 motor and solenoid
5322 520 10514	Base for ball bearing
5322 466 81408	Base for Y2 part
5322 520 20354	Ball bearing
	} PM8134
5322 530 50639	O ring on guide shaft

5.5.2. Y system (fig. 18 and 19)

5322 361 20383	Servomotor
5322 522 31673	Pinion 18t
5322 522 20296	Nylon gear with cord drum
5322 520 20354	Bearing
	} Y or Y1 - PM8134
5322 528 40246	Nylon gear with cord drum
5322 520 20354	Bearing
	} Y2 - PM8134
5322 466 81414	Support 1 (with 3 ball bearings)
5322 466 81415	Support 2 (with 3 ball bearings)
5322 526 20109	Magnet assy
5322 290 40182	Cord fixing hook
	Bearing
5322 462 10221	Nylon contact base
5322 278 80179	Sliding contact
	} Y1 and Y2 carriage PM8134
5322 466 81386	Carriage
5322 466 81388	Guide piece
5322 278 80179	Sliding contact
	} all types, except PM8134
5322 321 30274	Cord A4
5322 321 30276	Cord Y (Y1)
5322 321 30281	Cord Y2
5322 492 32261	Cord tension spring – all types
	} A3

Service code	Description
5322 528 80923	Cord guide pulley
5322 530 50641	O ring on guide shaft all types, except PM8134
5322 256 90479	Holder for Y arm — A4
5322 256 90482	Holder for Y (Y1) arm — A3
5322 256 90516	Holder for Y2 arm — PM8134
5322 520 20354	Ball bearing

5.6. WRITING SYSTEM

5322 256 90481	Cartridge holder	} all types, except PM 8134
5322 492 32262	Spring in holder	
5322 256 90511	Cartridge holder	} Y1 lower } PM8134
5322 492 32262	Spring in holder	
5322 532 60921	Nylon pin for penlift	
5322 256 90509	Cartridge holder	} Y2 upper } PM8134
5322 492 51589	Spring in holder	
5322 532 60922	Nylon pin for penlift	
PM9875 R/01	10 nylon cartridges red	
PM9875 B/01	10 nylon cartridges blue	

5.7. PEN LIFT (fig. 7)

5322 218 30192	Pen lift solenoid 12V (with core)	
5322 281 30159	Pen lift solenoid 6 V (with core)	
5322 115 80118	Resistor 56 Ω — 10 W	
5322 492 51528	Compression spring A4	
5322 492 51529	Compression spring A3	
5322 535 91594	Coupling pin in solenoid	
5322 462 10212	Operating lever	} A4
5322 405 20001	Coupling plate	
5322 466 81416	Operating lever	} Y A3 models (Y1)
5322 532 11075	Coupling bush in lever	
5322 466 81417	Coupling plate between lever-bar	
5322 466 81418	Operating lever Y2.	

5.8. CHART

5322 466 81404	Chart plate A4 size
5322 466 81405	Chart plate A3 size
5322 216 91673	LED p.c.b.
5322 130 31998	LED pin point LN 422 YP
5322 146 20784	HV transformer
5322 277 10688	Toggle switch CHART
5322 265 30259	4p connector on p.c.b.
5322 266 30163	4p connector on cable
PM9940/03	5 chart rolls A4
PM9951/03	5 chart rolls A3

Service code	Description
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5.9. CONNECTION CABLES-CONNECTORS

5322 321 20653	5p connection cable with socket connectors, length 10 cm
5322 290 60411	5p pin connector (on p.c.b.)
5322 321 20652	10p connection cable with socket connectors, length 10 cm
5322 321 20646	10p connection cable with socket connectors length 30 cm
5322 321 20647	10p connection cable with socket connectors length 70 cm
5322 290 60412	10p pin connector
5322 321 20651	15p connection cable with socket connectors length 20 cm
5322 263 70176	15p connection cable with socket connectors length 30 cm
5322 290 60413	15p pin connector
5322 265 30259	4p socket connector
5322 266 30163	4p connector (cable part)
	} for chart plate
5322 265 34068	5p socket connector
5322 265 34049	5p pin connector
5322 321 20654	Flat cable
5322 216 91689	Joint p.c.b. N8
	} in A3 models only
5322 265 54006	20p socket connector top entry
5322 267 64027	20p socket connector side entry
5322 267 64031	20p socket connector bottom entry
5322 267 64007	20p housing for pin contacts
5322 268 14013	Pin contact
5322 290 80584	{ Socket connector (rec. part)
—	{ Pin connector
	} "CHART TRANSPORT"
5322 290 60415	14p connector recorder part
5322 290 60414	14p connector cable part
	} "EXT. CONTROL"
	} for A4 models
5322 267 60122	24p connector recorder part
5322 265 51033	24p connector cable part
	} "EXT. CONTROL"
	} for A3 models

5.10. COMPONENTS

5.10.1. Preset potentiometers

5322 111 41118	200 Ω	20%	0,5 W
5322 111 41119	500 Ω		
5322 101 10469	1k		
5322 101 10471	5k		
5322 116 54324	10k		
5322 101 20686	20k		
5322 101 10472	50k		
5322 101 10486	100 Ω		

5.10.2. LED's

5322 130 31997	LED SY 403 DA – MAINS
4822 130 31249	LED LN 31 – TIME BASE ON
5322 130 31998	LED LN 422YP pin point

Service code	Description		
5.10.3. Integrated circuits			
5322 209 86355	LF 355N		
5322 209 81515	μ PC 151C		
5322 209 81078	μ PC 251C		
5322 209 81482	μ PC 254A		
5322 209 81514	μ PC 14315H	}	voltage regulators
5322 130 44844	MC 7915CT		
5322 130 44687	MC 78L05CP		
5322 209 85199	SN 74 LS 14N		
5322 209 85407	SN 74 LS 02N		
5322 130 90127	ON 3110 photocoupler		
5.10.4. Transistors			
5322 130 44651	74A037		
5322 130 44448	2SA564A		
5322 130 44558	2SA777		
5322 130 42024	2SB691		
5322 130 44257	2SC828A		
4822 130 41028	2SC1226A		
5322 130 44559	2SC1509		
5322 130 42025	2SD727		
5322 130 44659	2SK30A		
5.10.5. Diodes			
5322 130 34199	1S 953	35 V 100 mA	
5322 130 32001	RU2	1 A 600 V	
5322 130 31999	S1VB10	0.6 A 100 V	
5322 130 34476	S4VB10F	4 A 100 V	
5322 130 31987	UF2	1 A 600 V	
4822 130 30877	V06B	1.3 A 600 V	
5.10.6. Zener diodes			
5322 130 34855	1SZ51	6 V 75 mA	
5322 130 31995	XZ066	6.6 V 500 mW	
5322 130 34844	XZ082	8.2 V 500 mW	
5322 130 31996	XZ096	9.6 V 500 mV	
5322 130 32002	XZ107	10.7 V 500 mV	
5322 130 34857	XZ132	13,2 V 500 mV	
5322 130 31598	YZ060C	6 V 0,5 W	
5.10.7. Resistors			
5322 116 51649	50 Ω	0,1%	0,25 W
5322 116 51691	100 Ω	0,1%	0,25 W
5322 116 51689	150 Ω	0,1%	0,25 W
4822 110 73063	200 Ω	0,1%	0,25 W
5322 116 51651	250 Ω	0,1%	0,25 W
5322 116 51652	500 Ω	0,1%	0,25 W
5322 116 50285	1k	0,1%	0,25 W
4822 110 73112	1k5	0,1%	0,25 W
5322 116 51687	2k	0,1%	0,25 W
5322 116 51653	2k5	0,1%	0,25 W
5322 116 51656	5k	0,1%	
5322 116 51683	6k	0,1%	
5322 116 50276	10k	0,1%	
4822 110 73138	15k	0,1%	
5322 116 51019	900k	0,1%	

5322 116 51688	20k	0,1%	
5322 116 51684	23k		
5322 116 51654	25k	0,1%	1/4 W
5322 116 51655	50k		
5322 116 51685	60k		
5322 116 50462	100k		
5322 116 50448	200k		
5322 116 51686	600k	0,1%	0,25 W
5322 116 51021	999k		
5322 111 40009	47E	5%	1 W
4822 110 10076	68E	5%	1 W
5322 116 54171	2k21	1%	0,5 W
5322 116 90128	100 M	0,5%	0,5 W
4822 116 51331	1k2	5%	0,5 W
5322 116 90117	8 x 15E	10%	0,125 W network
4822 116 51279	1 M	1%	0,5 W

5.10.8. Capacitors

5322 122 34034	100 pF	± 10%	50 V
5322 122 54003	4700 pF	+ 100 —0%	1.4 kV
5322 121 41723	0.022 μ F	10%	50 V
5322 121 41724	0.047 μ F	10%	600 V
4822 121 40523	0.068 μ F	10%	50 V
4822 121 40239	0.047 μ F	10%	50 V
5322 122 31652	0.01 μ F	+80 to —20%	50 V
5322 122 31894	0,22 μ F	2%	100 V
5322 124 14075	1 μ F	± 20%	50 V
5322 124 64014	1 μ F	+30 to —10%	450 V
4822 124 20696	3, 3 μ F	20%	25 V
5322 124 21321	4, 7 μ F	+30 to —10%	450 V
5322 124 24089	10 μ F	±20%	16 V
5322 124 14033	10 μ F	+30 to —10%	35 V
5322 124 20164	10 μ F	5%	100 V
5322 124 24089	10 μ F	+100 to —10%	16 V
4822 124 20699	47 μ F	+100 to —10%	25 V
5322 124 21318	100 μ F	+30 to —10%	35 V
5322 124 21319	470 μ F	+30 to —10%	35 V
5322 124 21322	2200 μ F	+30 to —10%	35 V
5322 124 40666	10 000 μ F	+30 to —10%	35 V

5.11. CHART TRANSPORT UNITS PM9882 (A4) PM9883 (A3 size) (fig. 21, 22 and 23)

5.11.1. FRONT CONTROLS

Service code	Description
5322 105 30138	Speed selector Knob
5322 414 70017	Insert
5322 277 10681	Toggle switch { MIN-HOUR FRAME ON-OFF FORWARD-REVERSE
5322 277 10683	Toggle switch "START-STOP"
5322 277 10682	Cap for toggle switches
4822 130 31249	LED LN31

5.11.2. P.C.B.'S

5322 216 91637	P.c.b. N1 (with control switches)
5322 216 91636	P.c.b. N2

5.11.3. COMPONENTS

4822 209 10118	TC4001 VBP
4822 209 10247	μ PD 4011C
4822 209 10252	μ PD 4023C
4822 209 10255	μ PD 4027C
4822 209 10302	μ PD 4518C
4822 209 10287	μ PD 4519C
5322 209 81483	μ PA 53C
5322 130 44687	MC 78 LO 5CP
4822 209 10289	MC 14526 B
5322 209 14573	MC 14566 BCP
4822 130 44257	2 SC 828 A
4822 130 30877	V06B
5322 130 34199	1S953
5322 209 83393	SDB 520
4822 121 40523	0.068 μ F 10% 50 V
4822 122 31414	0.01 μ F 10% 50 V
5322 124 14062	1 μ F +30% -10% 50 V
5322 124 10012	100 μ F +30 -10% 16 V
5322 290 80584	7 p cable plug
5322 321 20651	15 p connection cable with 2 socket connectors length 20 cm
5322 265 44096	15 p connector on p.c.b.

5.11.4. CHART DRIVE

5322 361 10263	Drive motor		
5322 522 31666	Gear on motor shaft (48 t)		
5322 522 31664	Gear (40 t) on sprocket roller		
5322 522 31665	Nylon gear (34 t)		
5322 532 11054	Slip ring	} slip coupling	
5322 492 51515	Spring		
5322 535 70772	Shaft (brass)		
5322 535 70771	Nylon flange with shaft		
5322 466 91422	Nylon flange		
5322 492 51516	Spring		
5322 446 81375	Bearing plate (drive motor side)		
5322 446 81376	Bearing plate		
5322 532 80742	Sprocket roller without sprocket wheels	} PM9882	
5322 535 91568	Shaft for sprocket roller		
5322 535 91571	Chart pressure bracket		
5322 532 80743	Sprocket roller without sprocket wheels	} PM9883	
5322 535 91581	Shaft for sprocket roller		
5322 535 91571	Chart pressure bracket		
5322 522 31663	Sprocket wheel		
5322 535 91569	Shaft	} shaft assy	} PM9882 only
5322 528 70397	Support		
5322 528 70396	Roller		

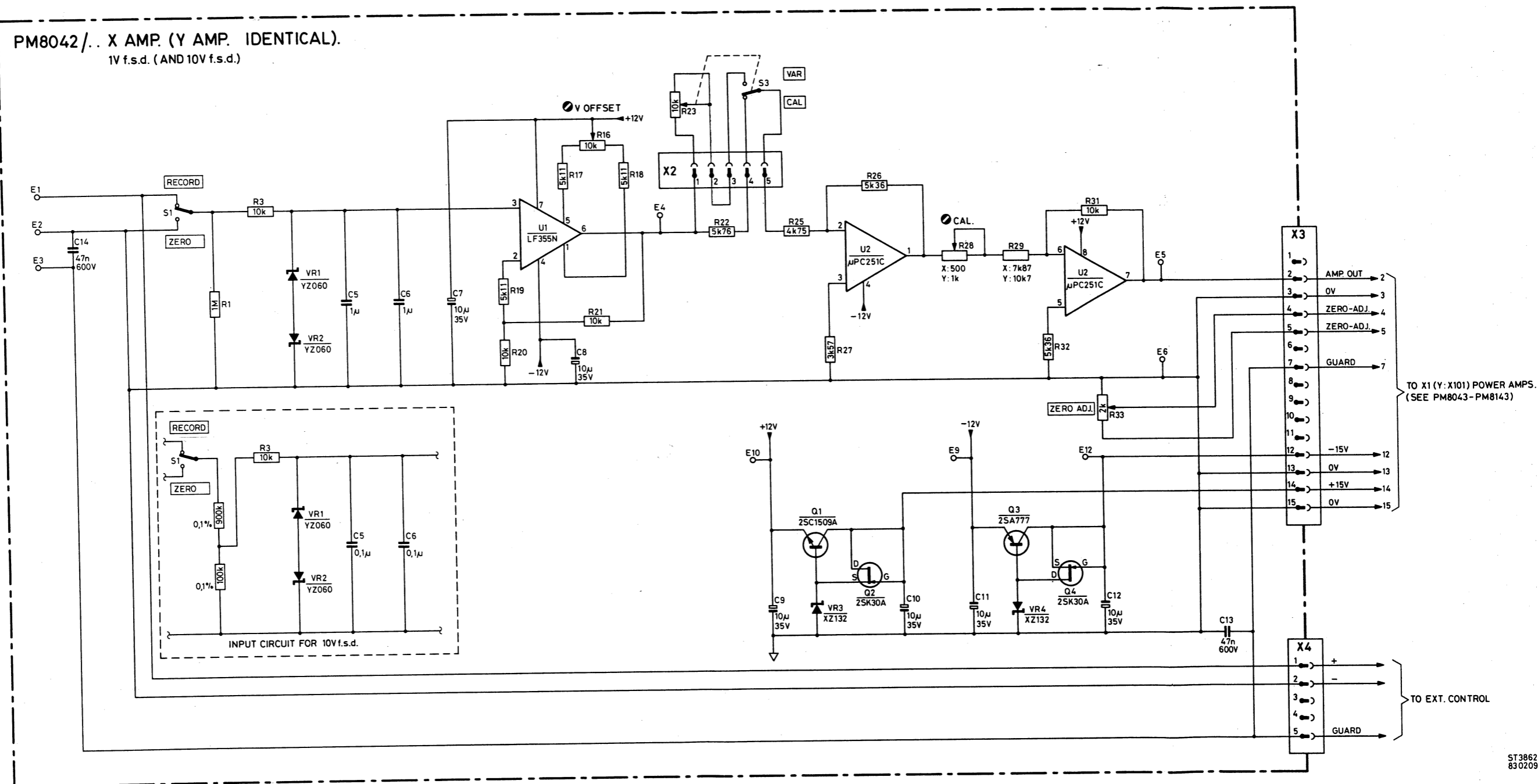


Fig. 1 X-Y amps PM8042

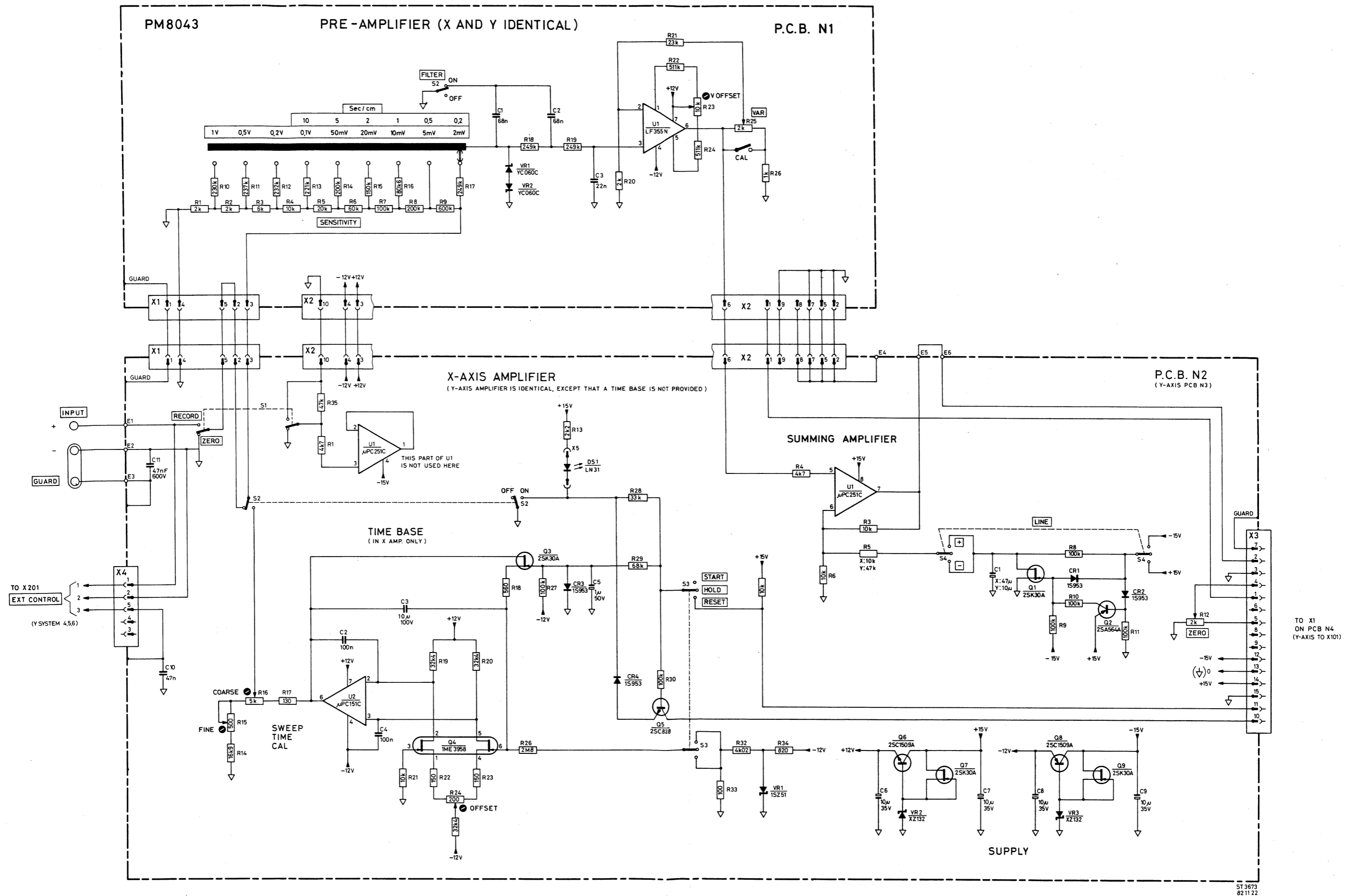


Fig. 2 Pre-amps + X (Y) amp PM8043

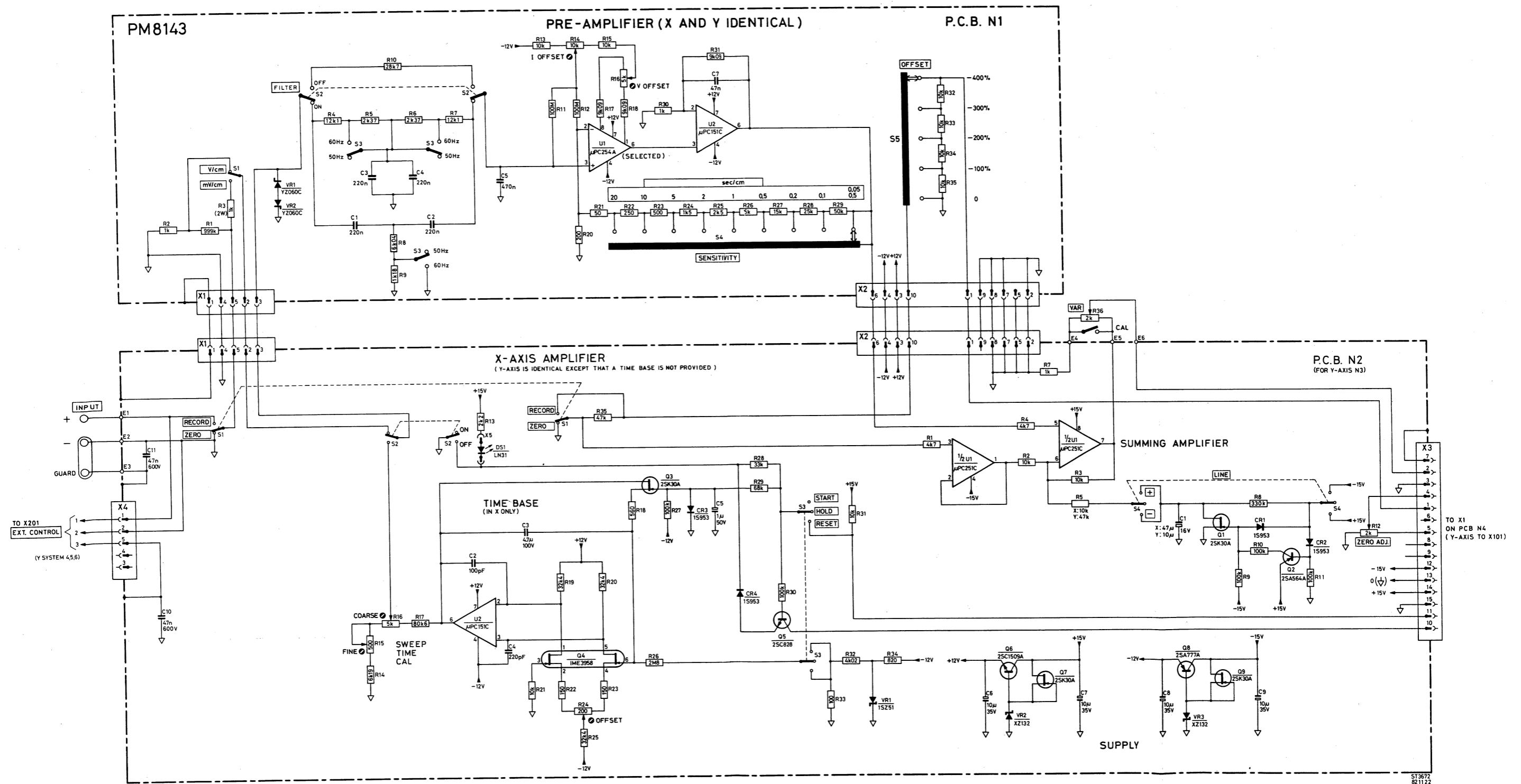
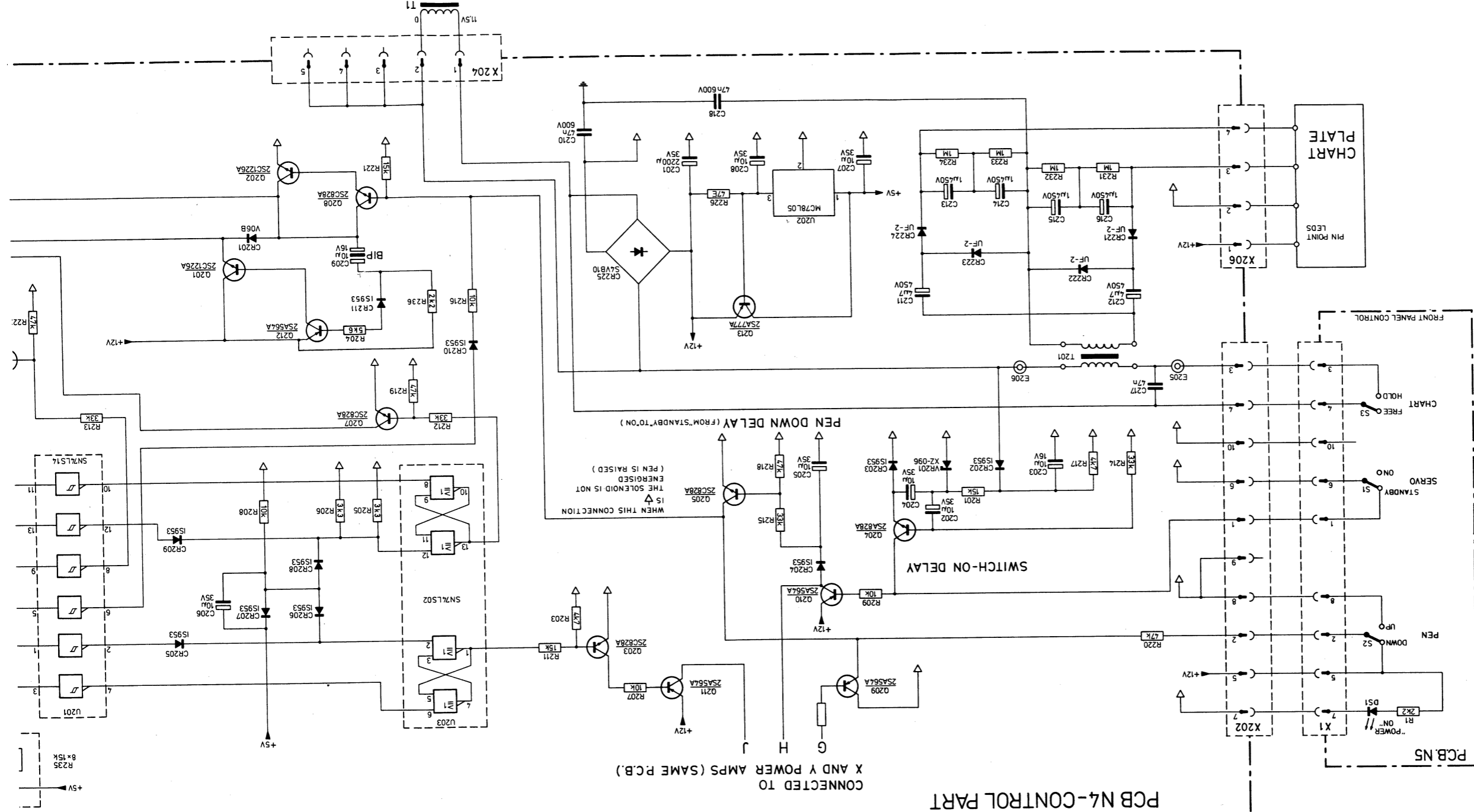




Fig. 4 X (Y) power amp PM8043-PM8143

PM8043-PM8143 PCB N4-CONTROL PART

CONNECTED TO
X AND Y POWER AMPS (SAME PCB.)



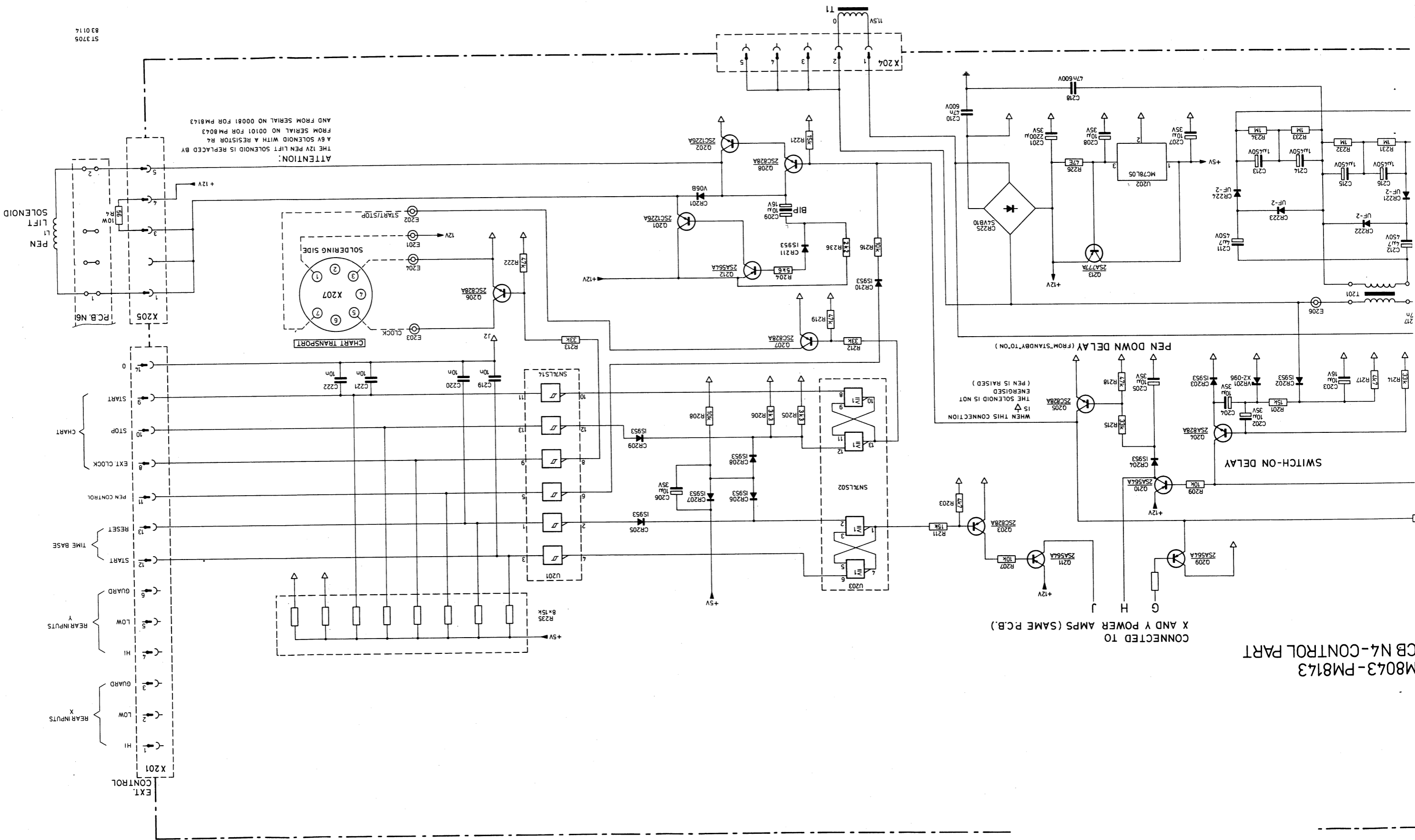
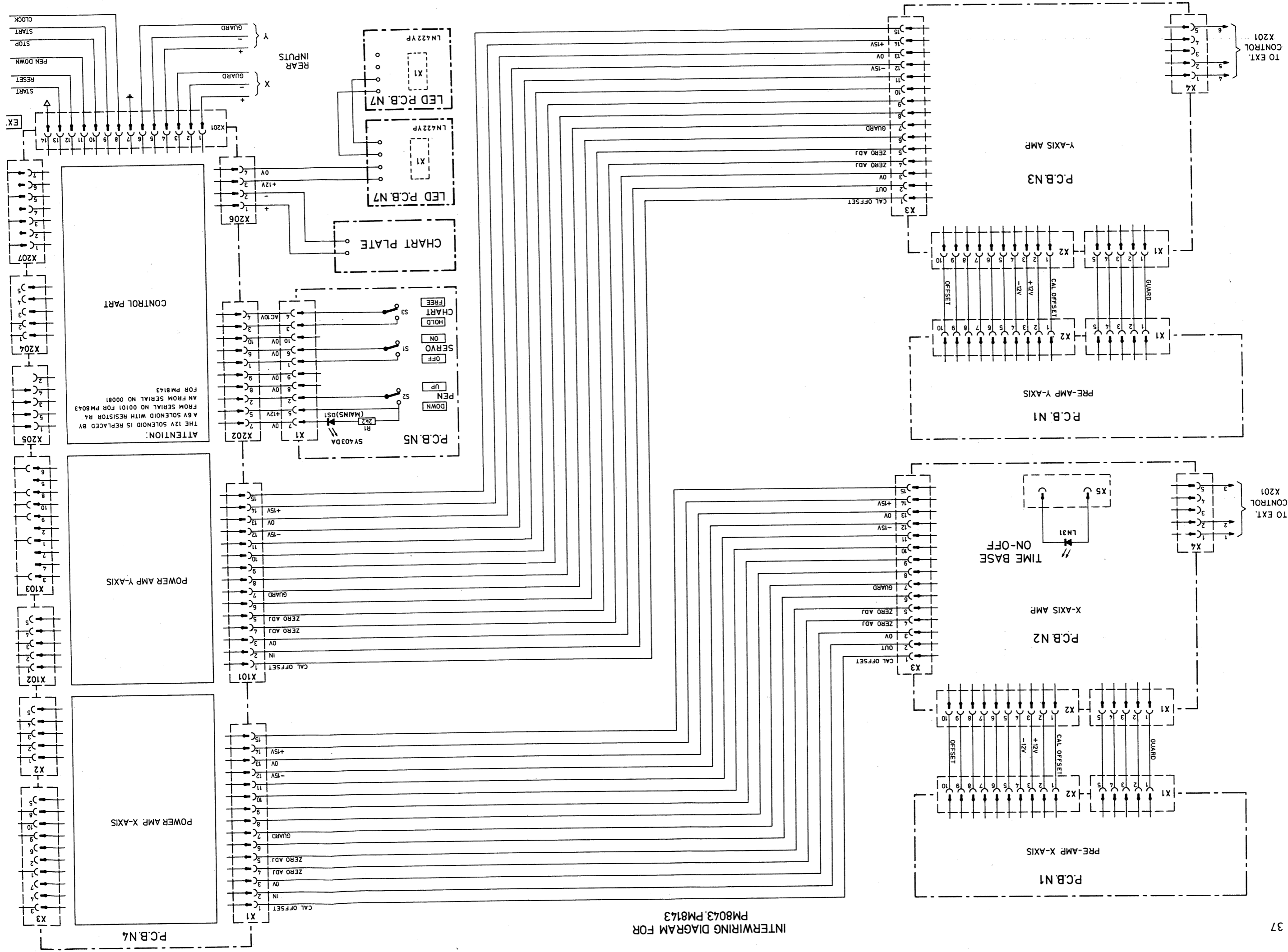


Fig. 5 Control part PM8043-PM8143

CB N4-CONTROL PART
M8043-PM8143

INTERWIRING DIAGRAM FOR
PM8043, PM8143

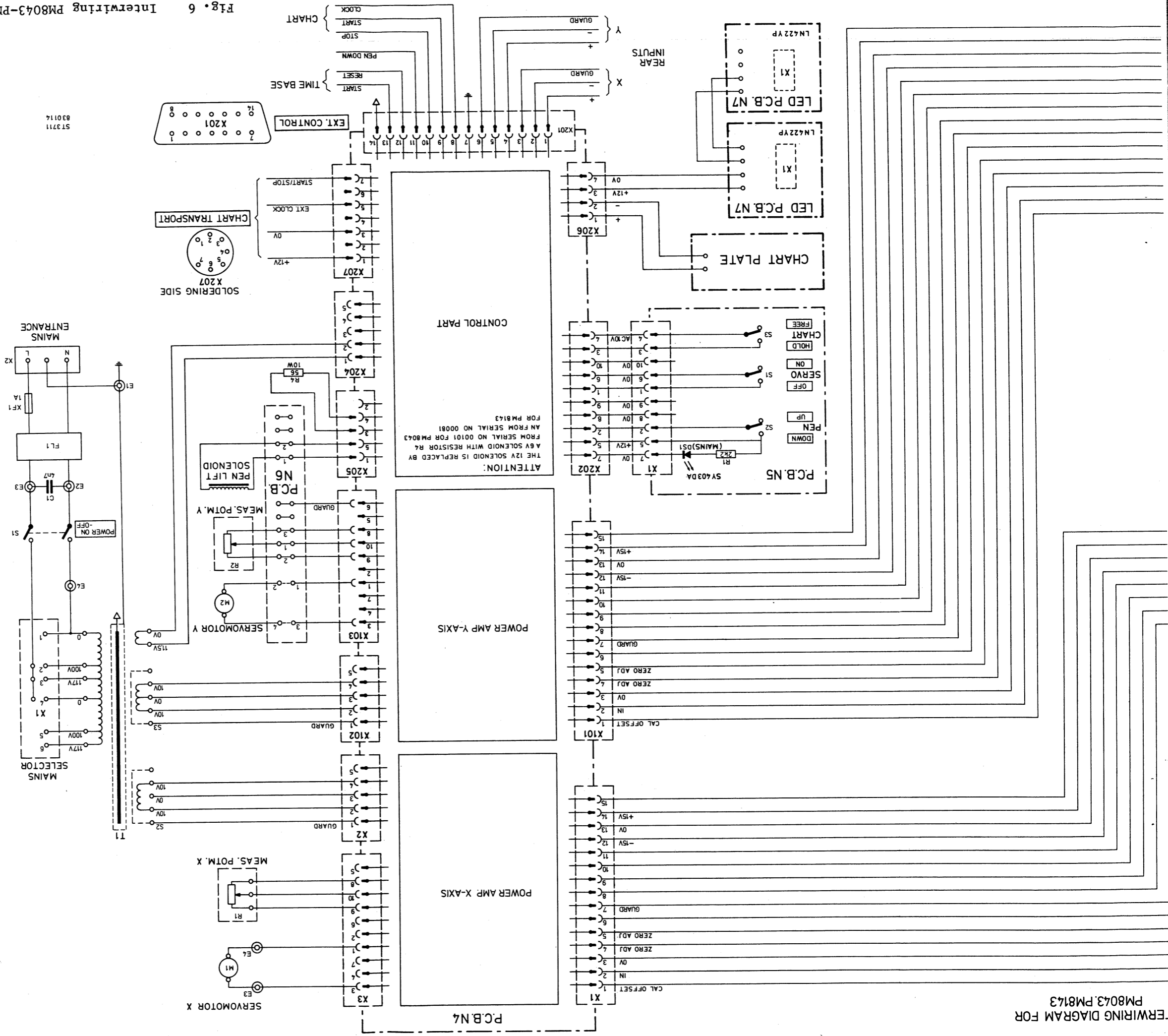
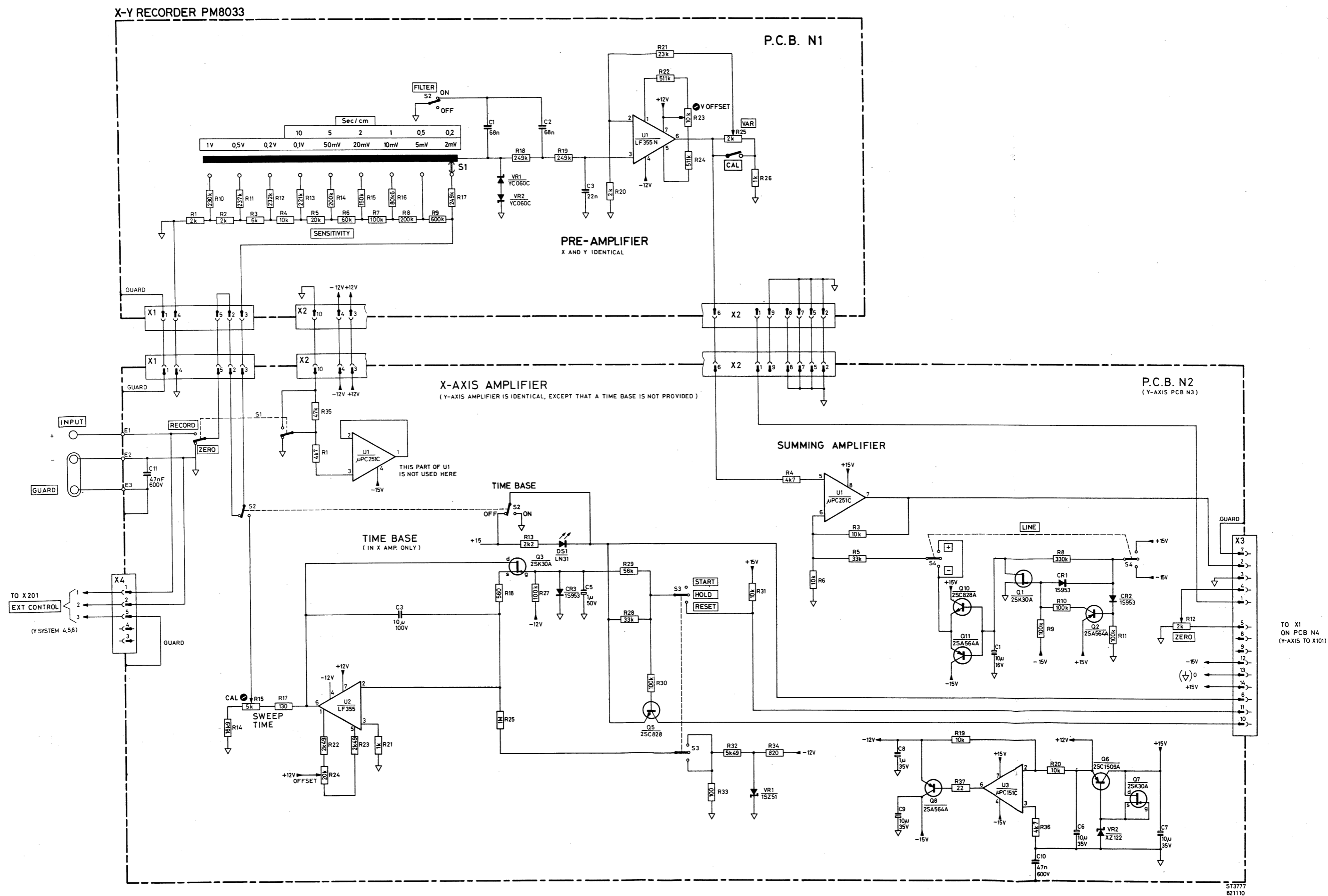


Fig. 6 6 Interwiring PM8043-PM8143



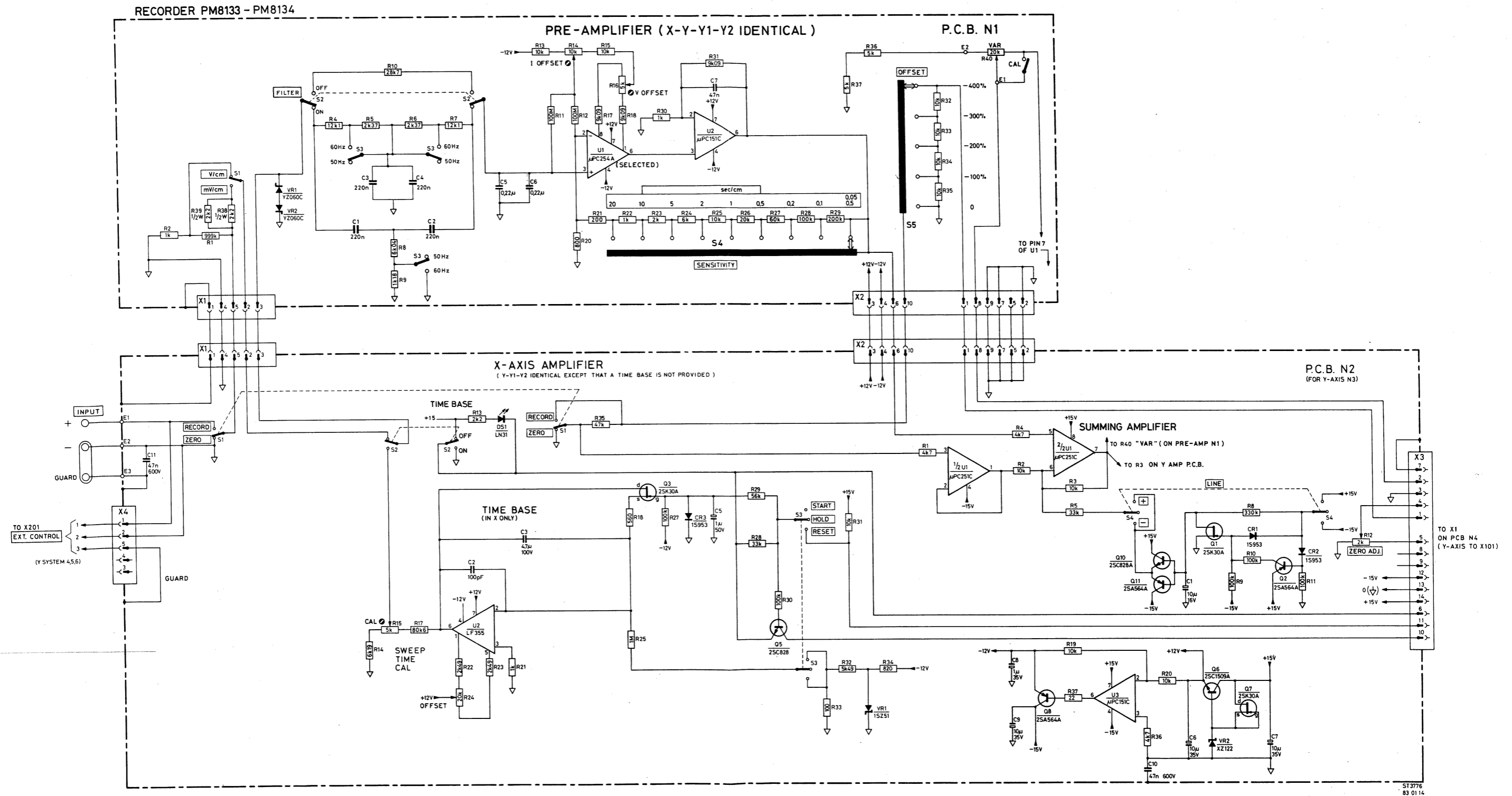


Fig. 8 Pre-amp + X (Y) amp PM8133-PM8134

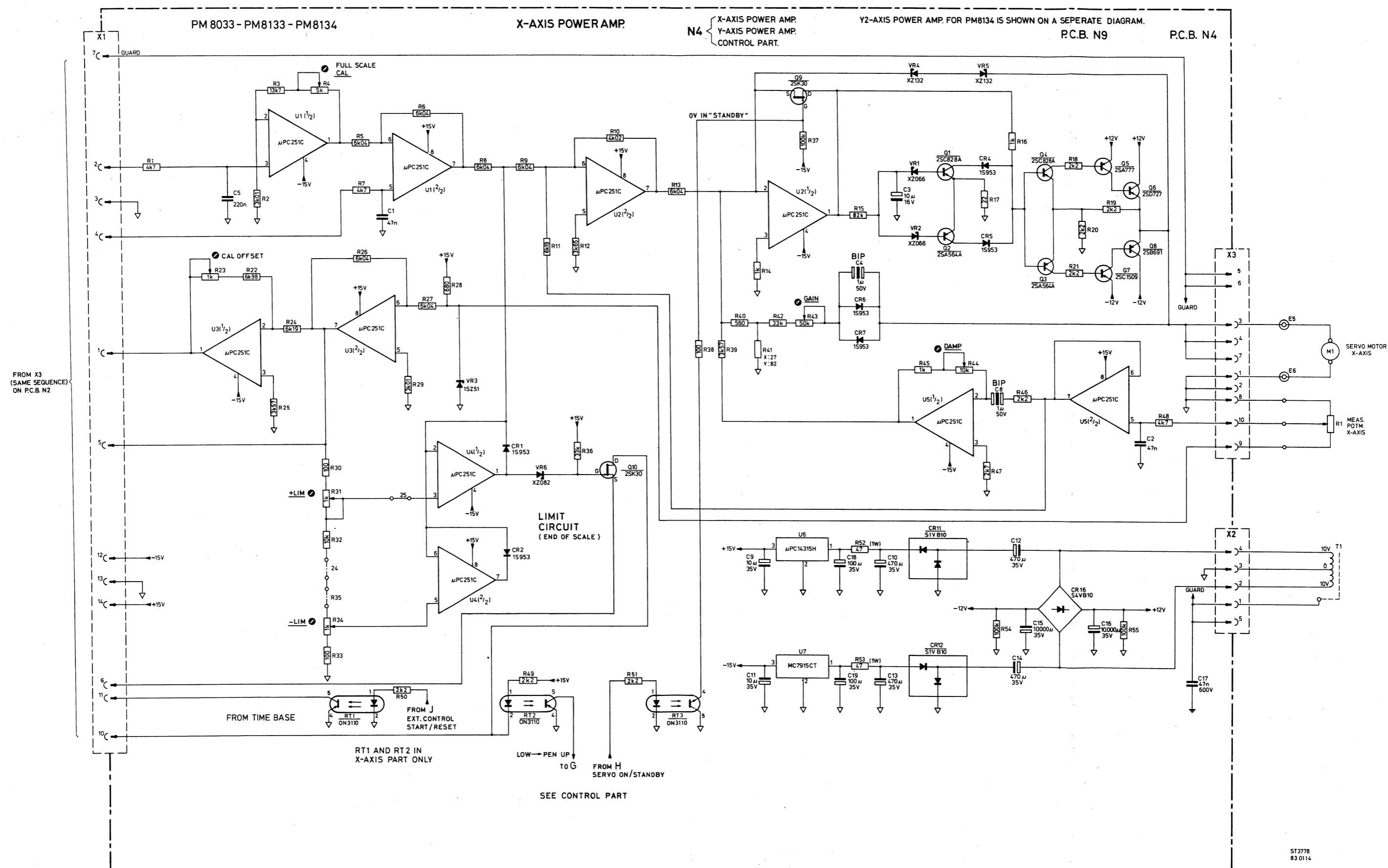


Fig. 9 X axis power amp PM8033-PM8133-PM8134

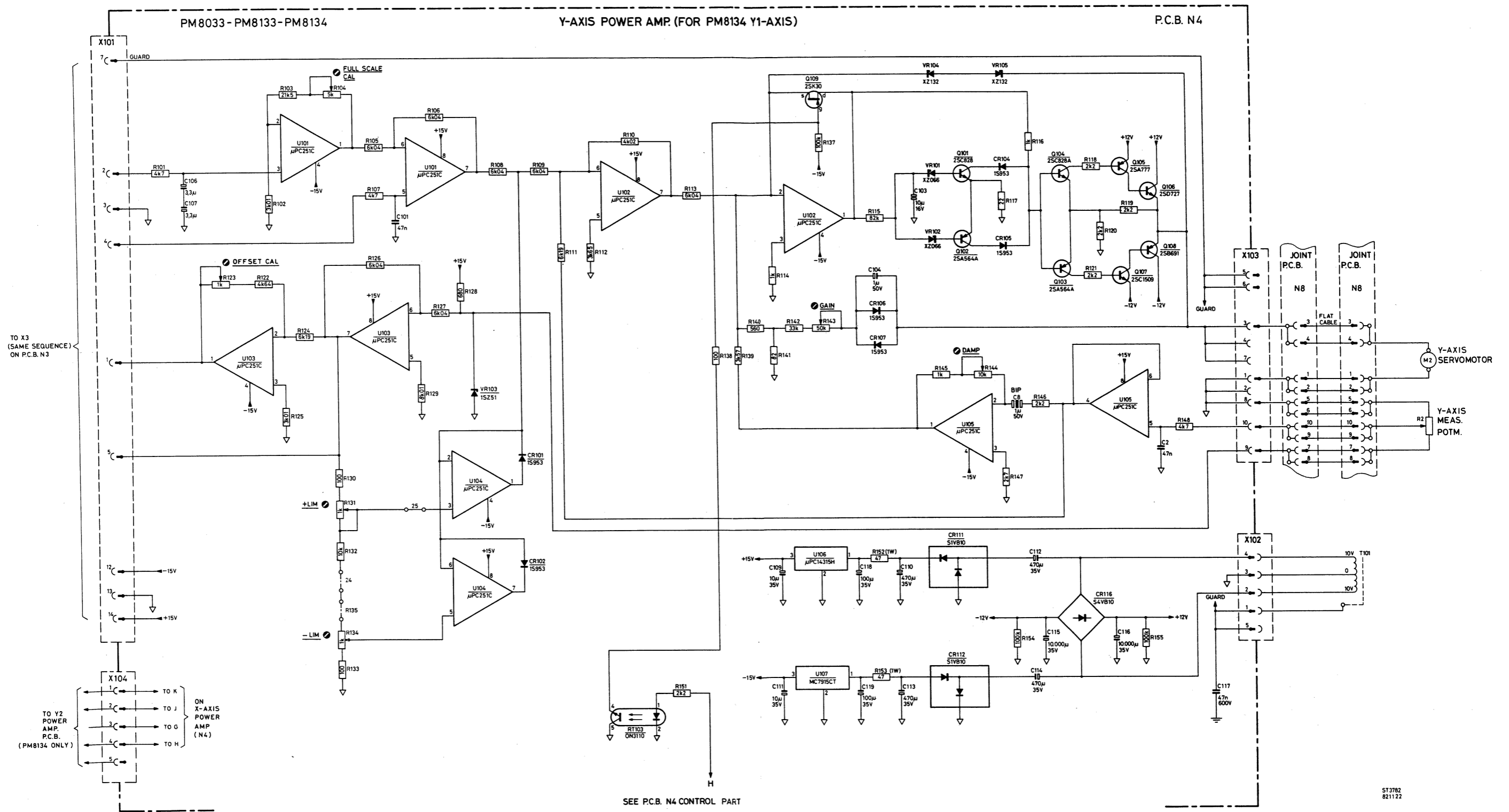
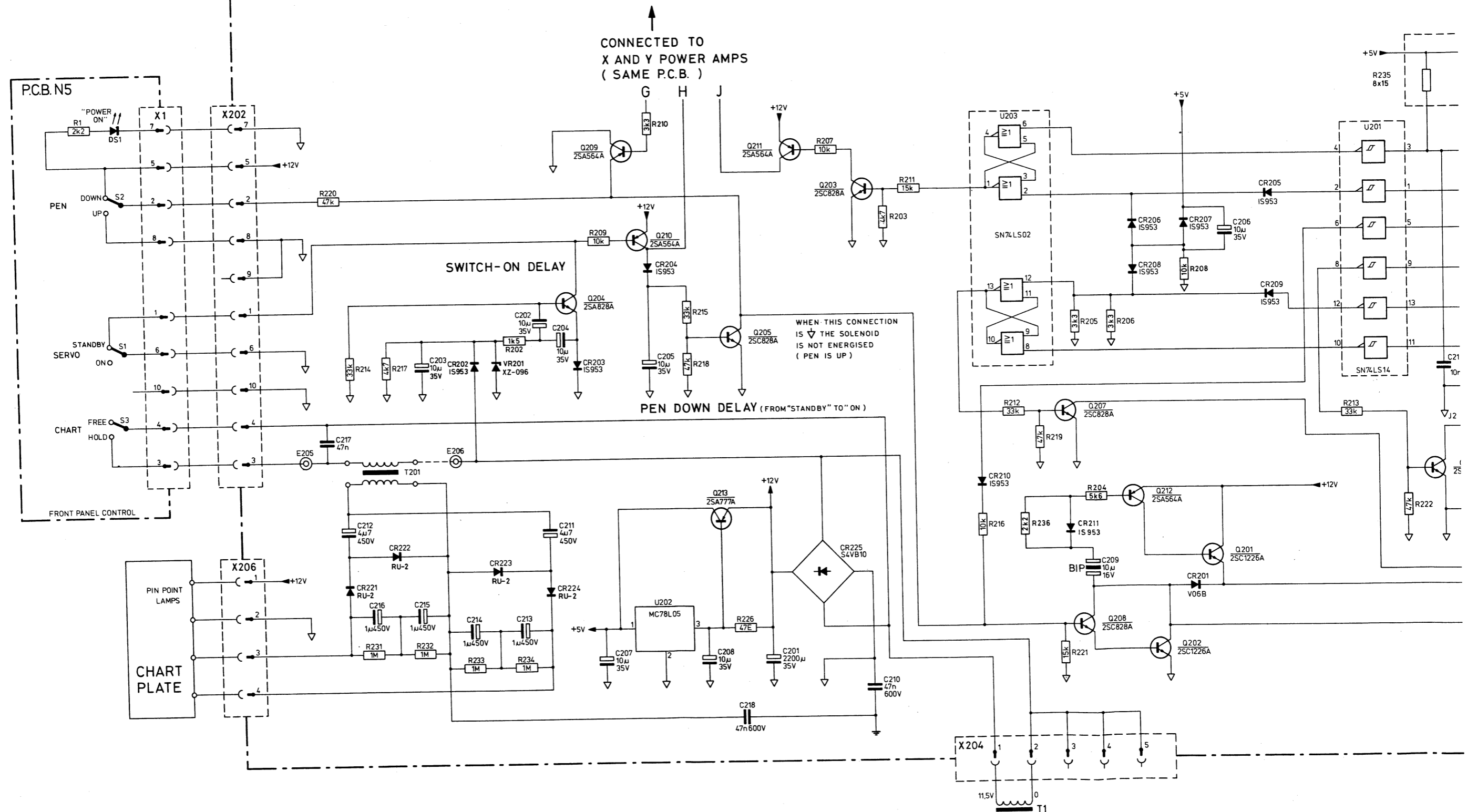


Fig. 10 Y axis power amp PM8033-PM8133-PM8134

PM8033-PM8133-PM8134 CONTROL PART



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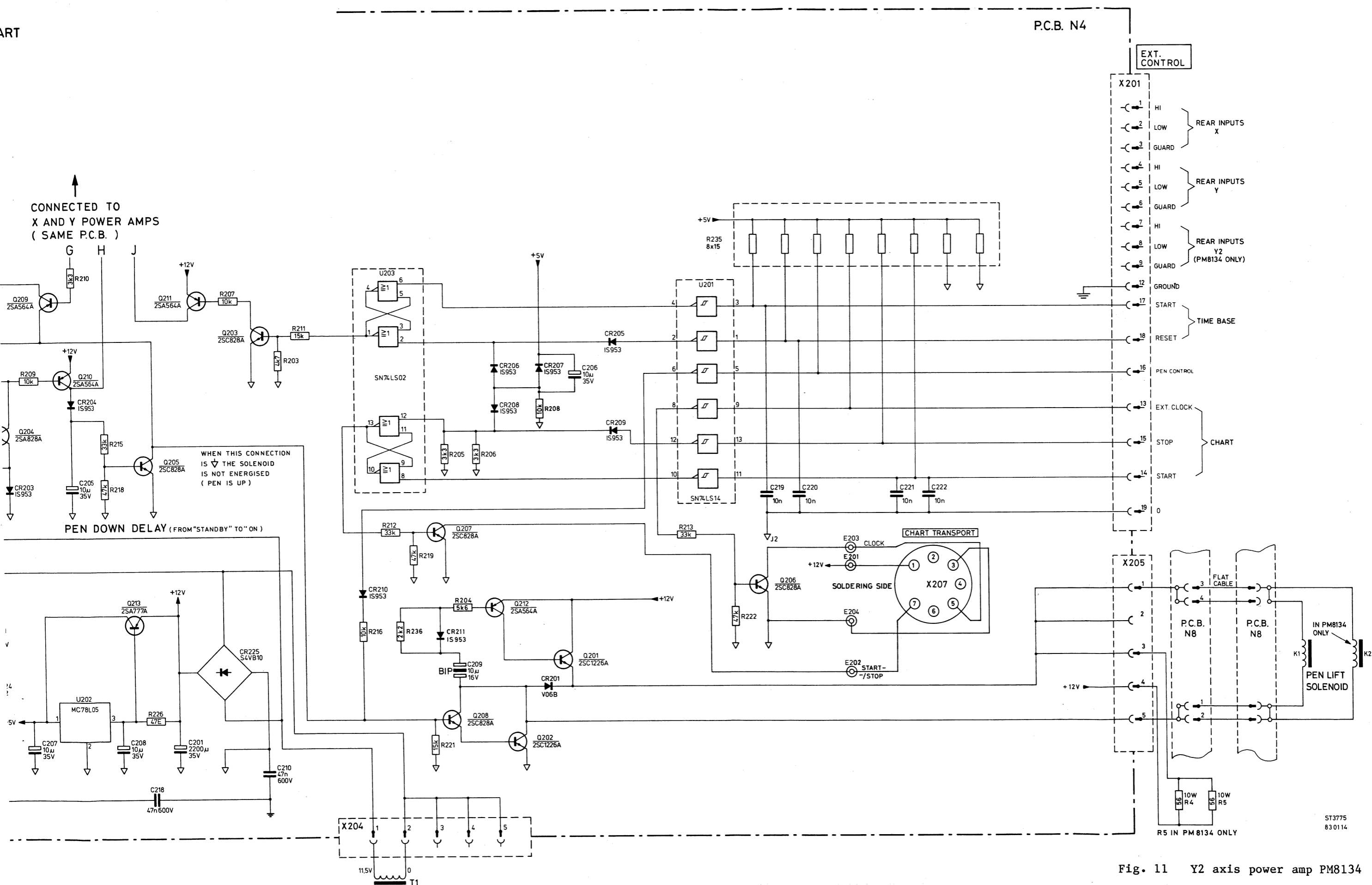
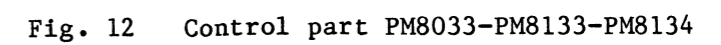


Fig. 11 Y2 axis power amp PM8134



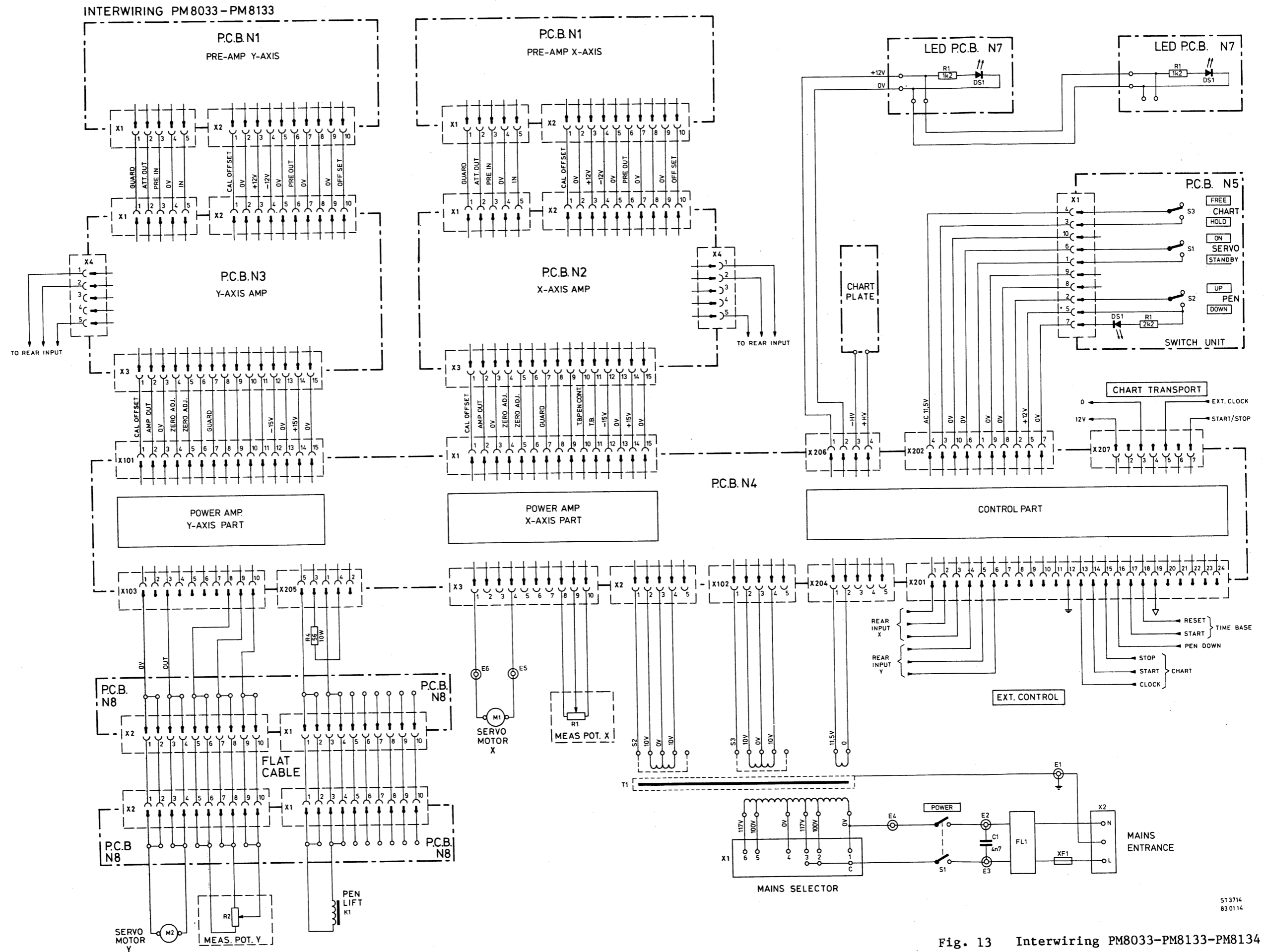
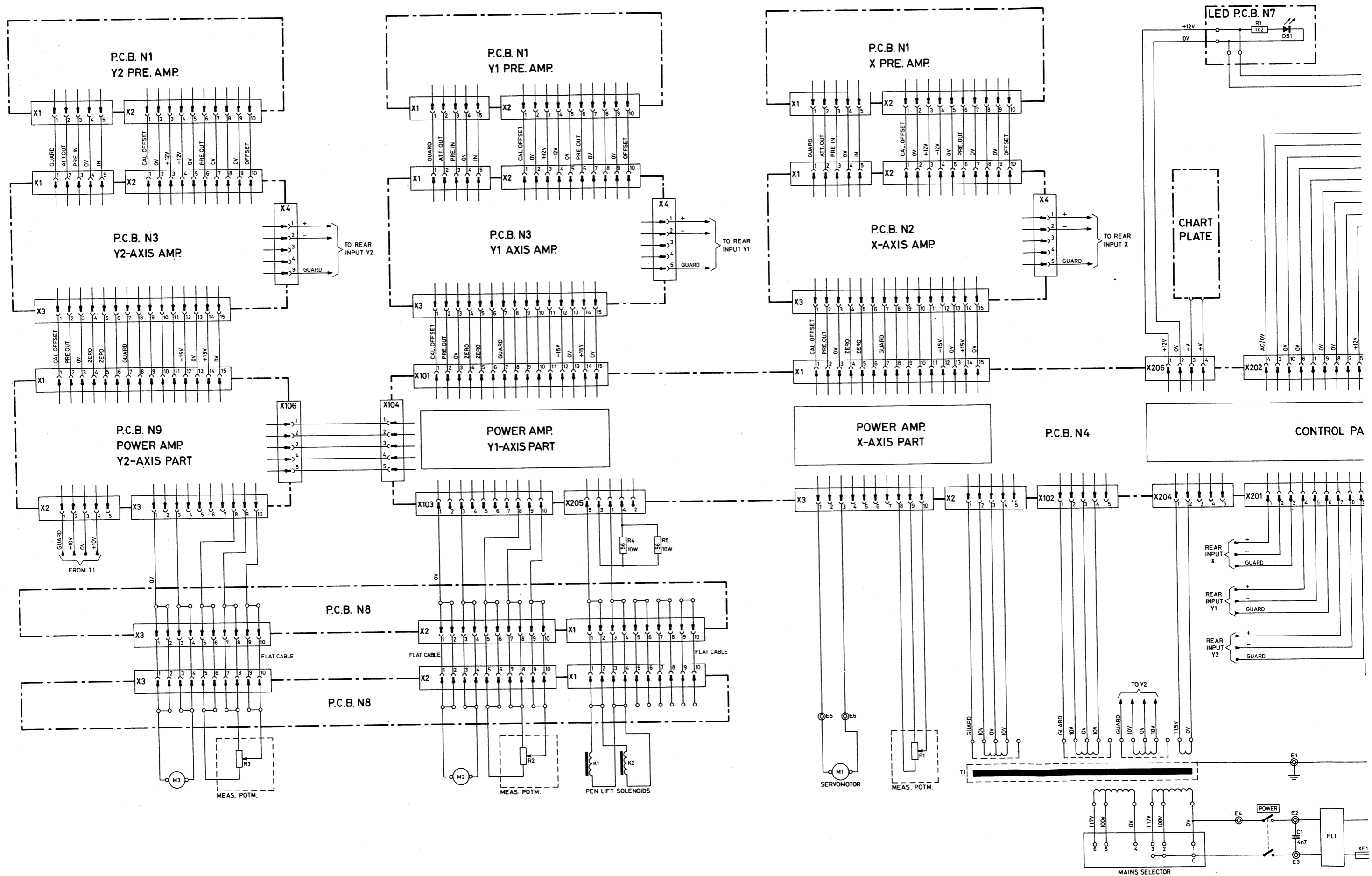


Fig. 13 Interwiring PM8033-PM8133-PM8134



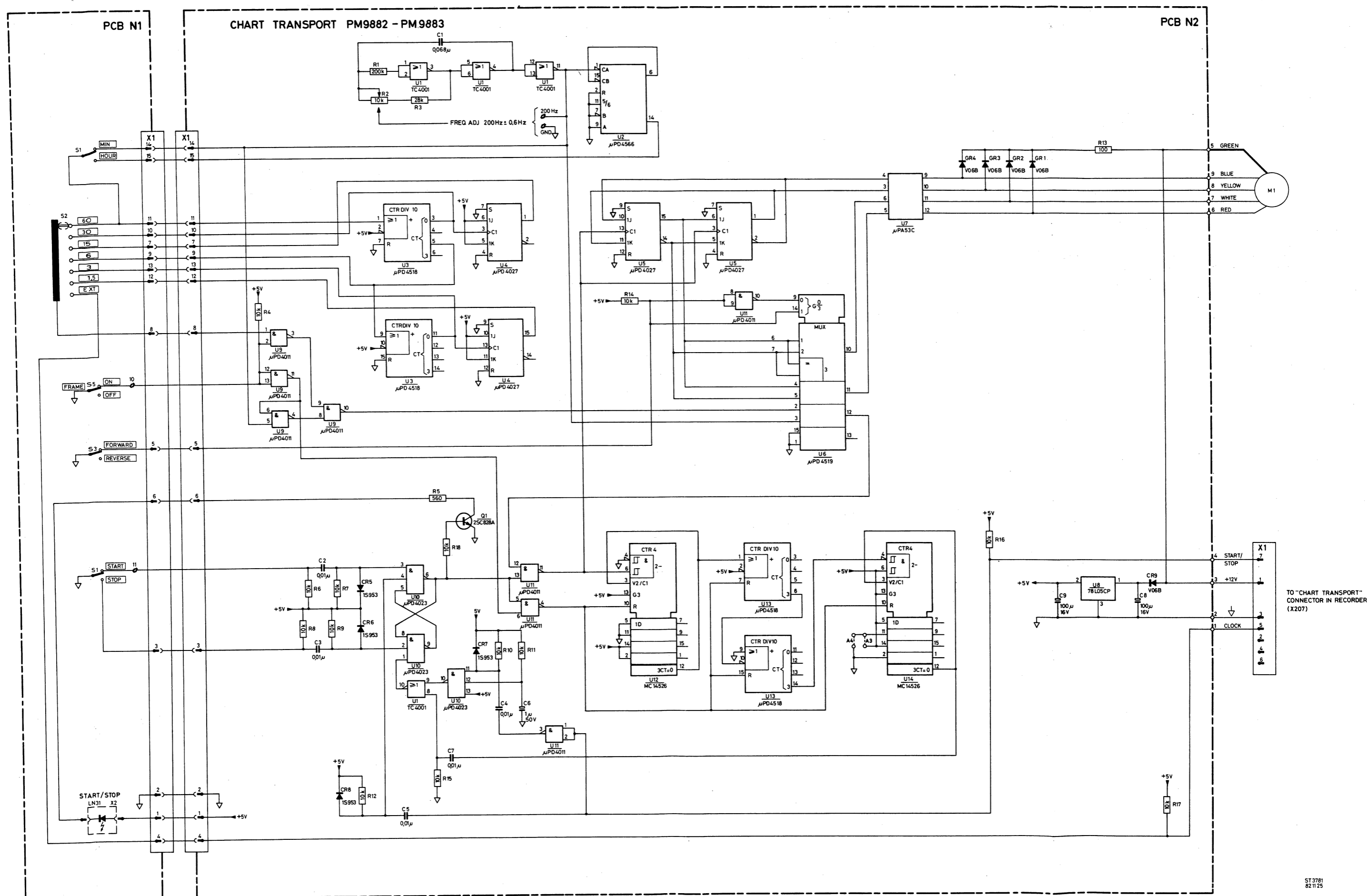


Fig. 15 Chart transport units PM9882-PM9883

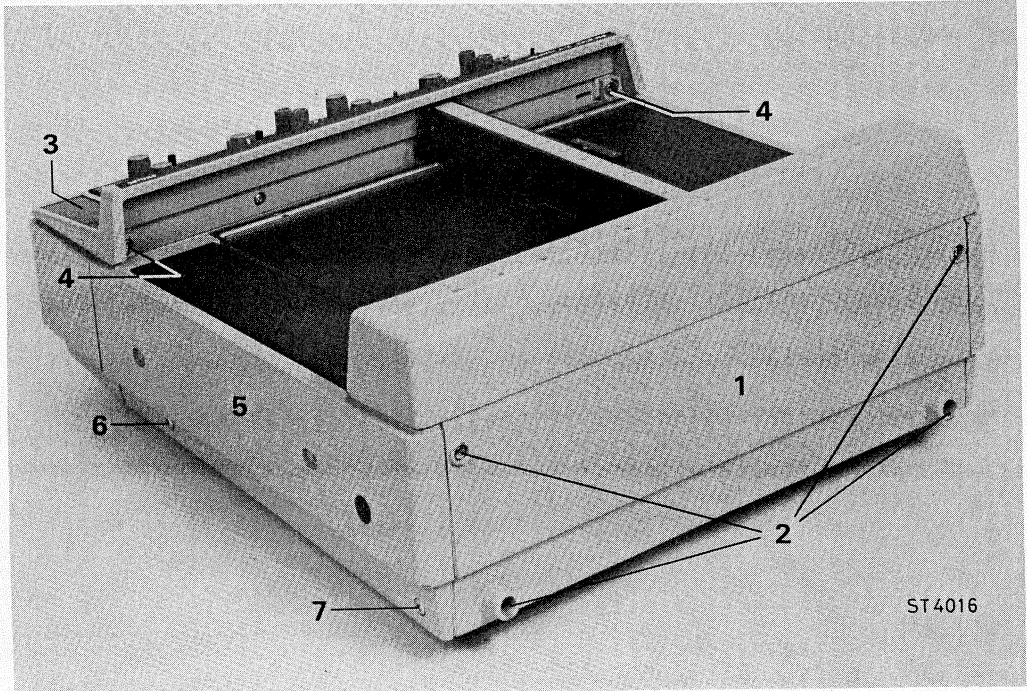


Fig. 1

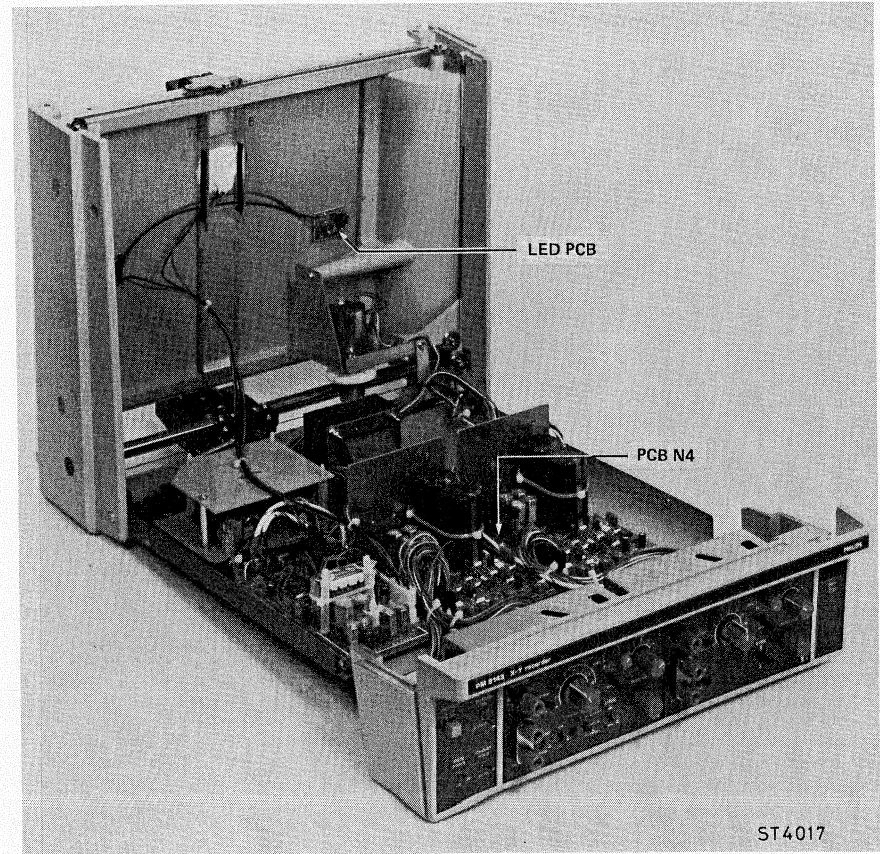


Fig. 2

Fig. 1-4 Opening the recorder

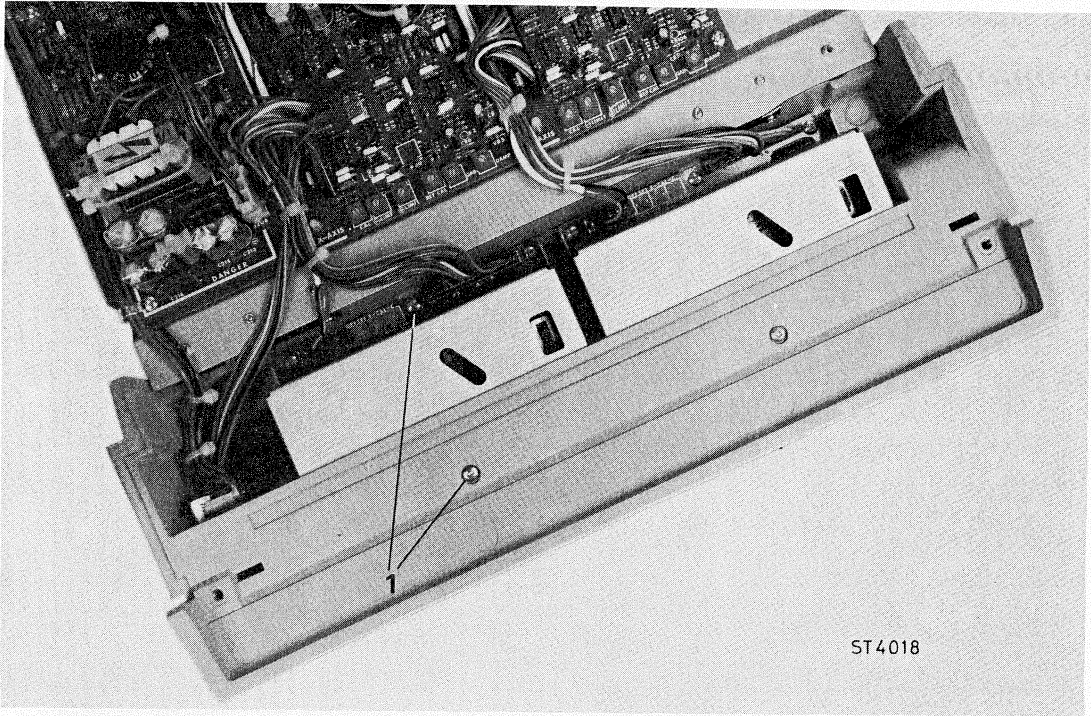


Fig. 3

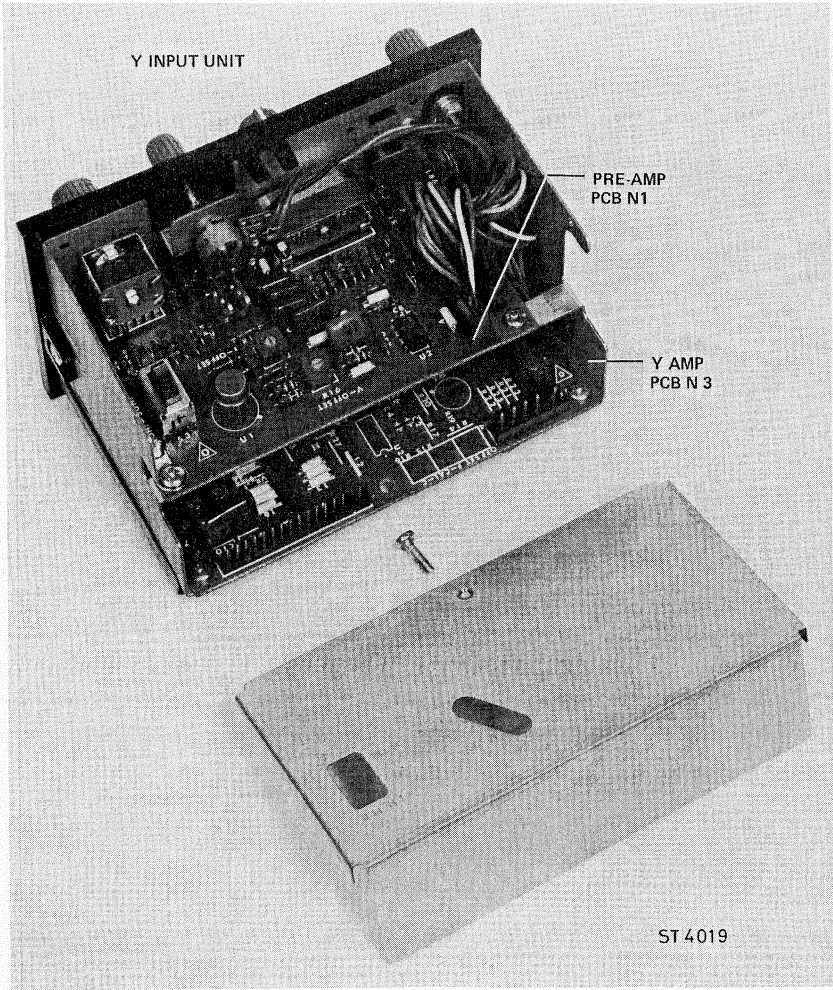


Fig. 4

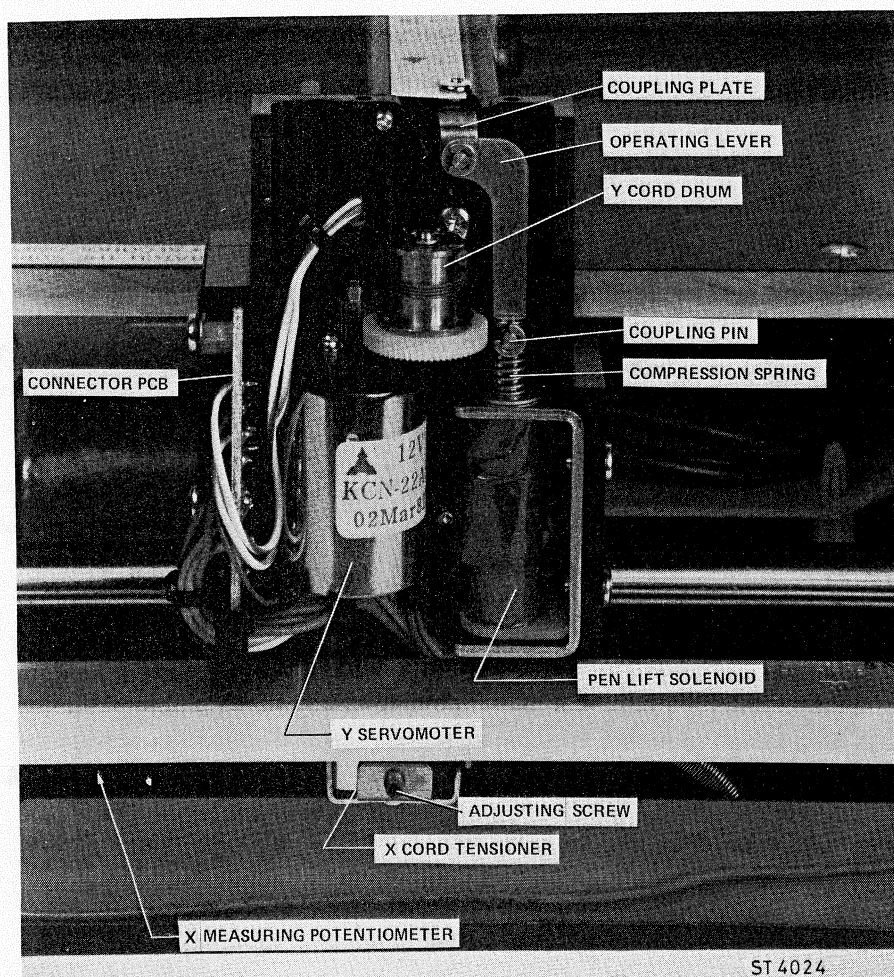
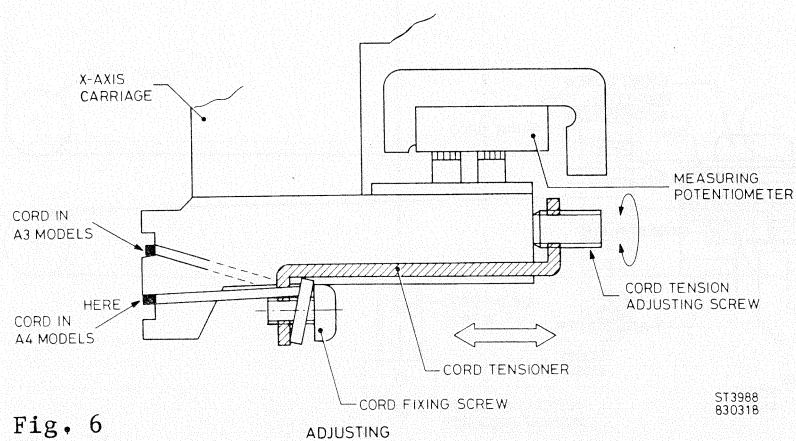
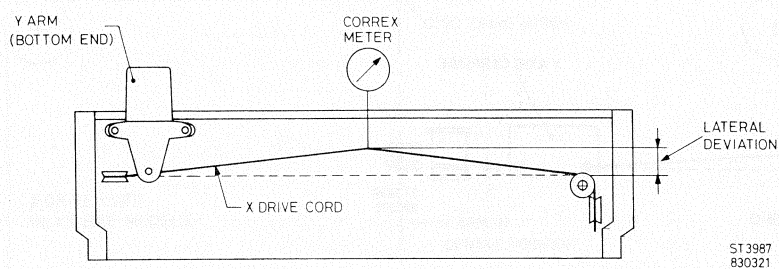


Fig. 7

Fig. 5-12 Drive cords

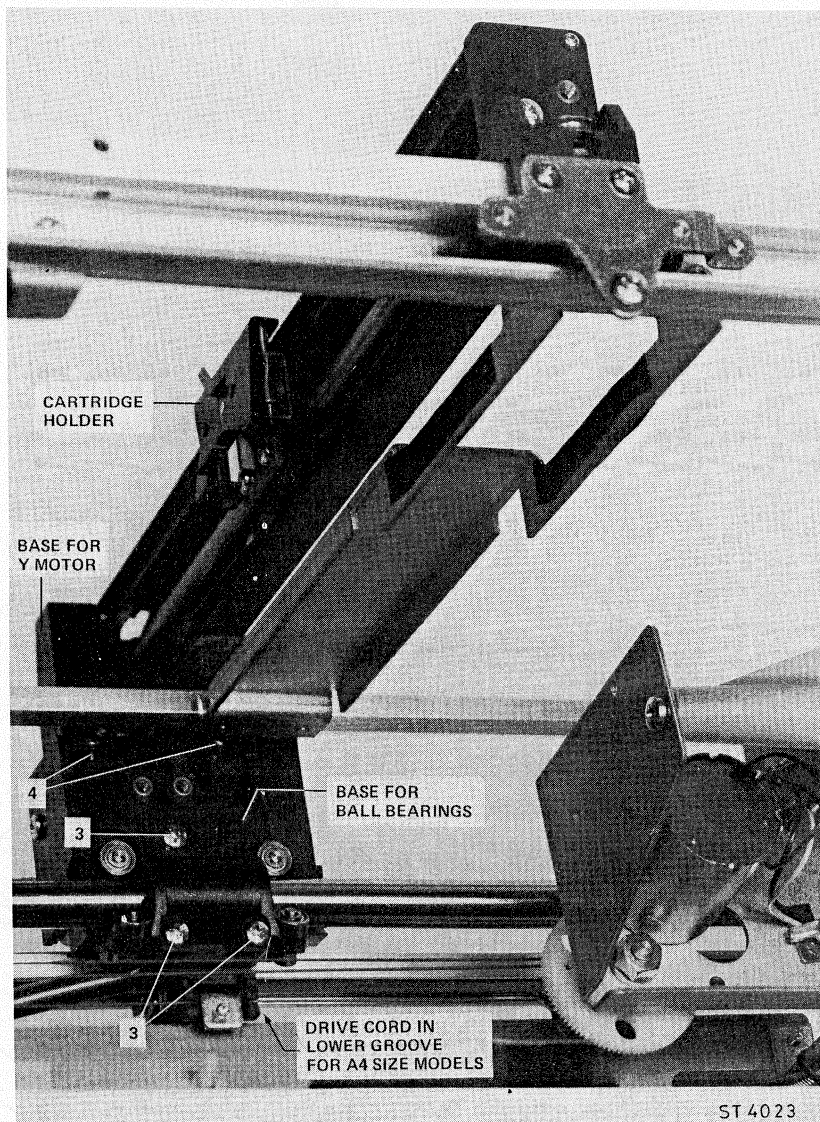
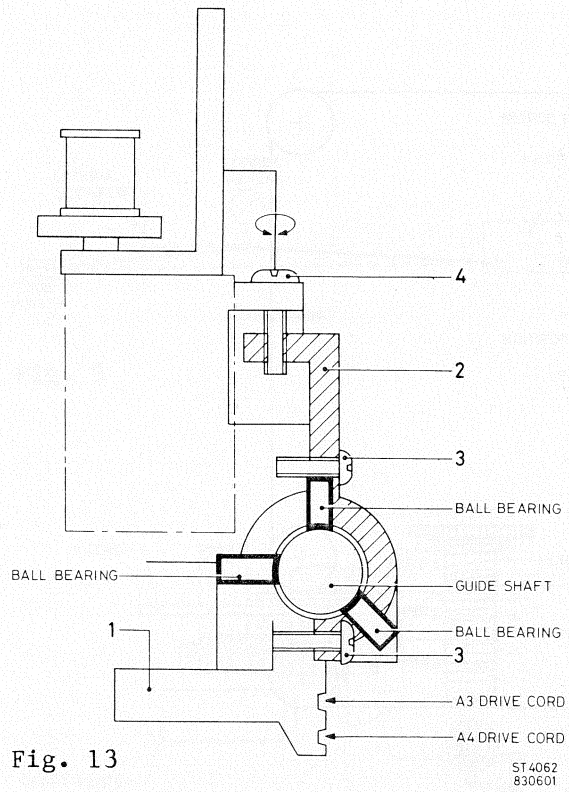


Fig. 14

Fig. 13-14 X carriage

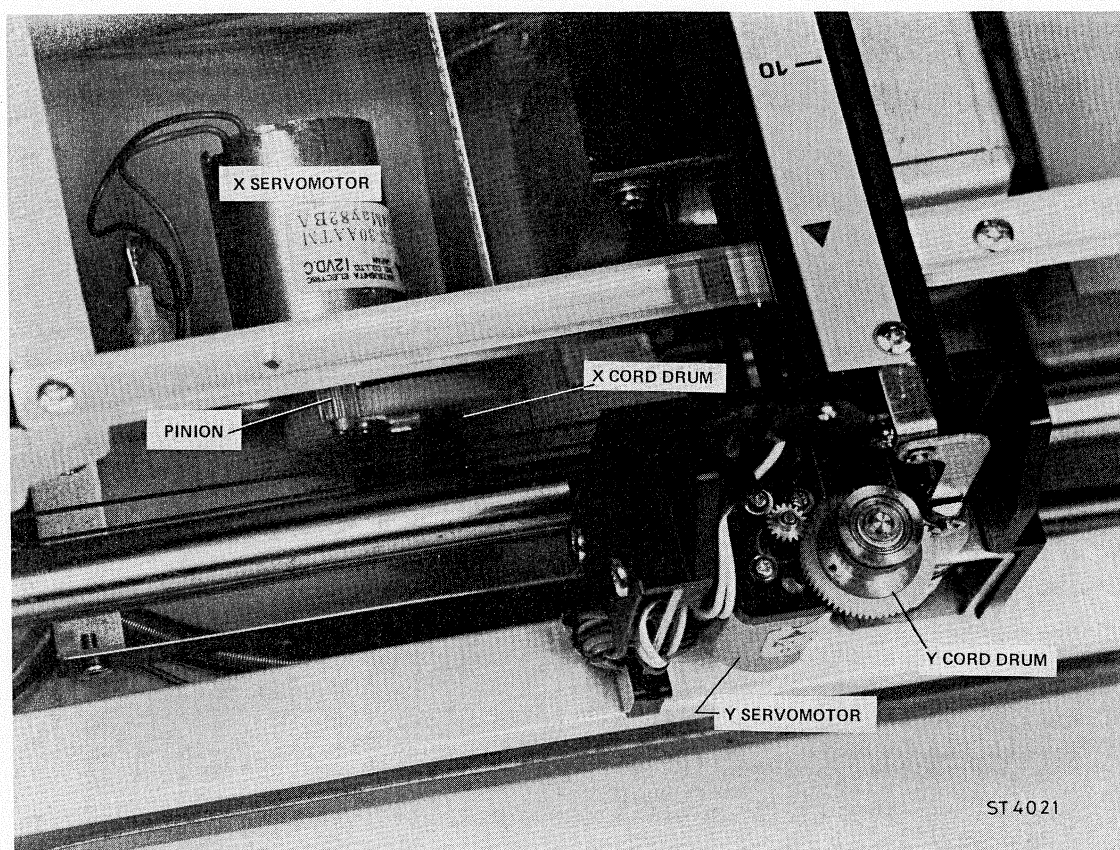


Fig. 15 Servomotors

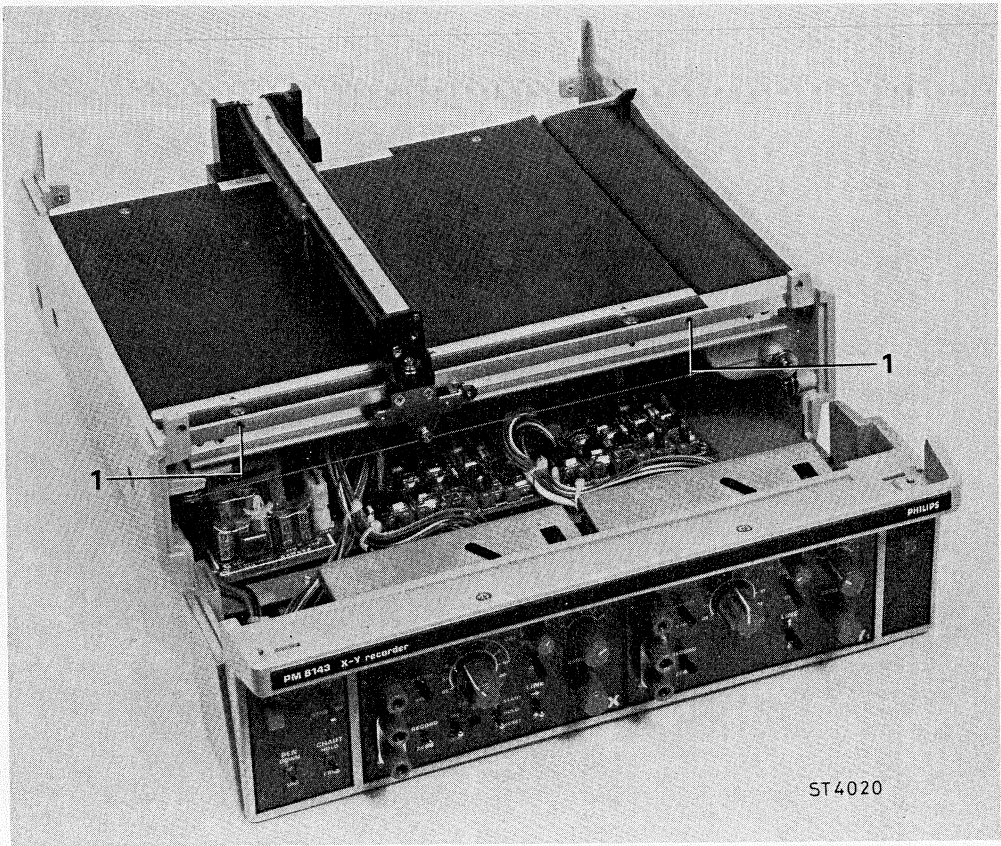


Fig. 16

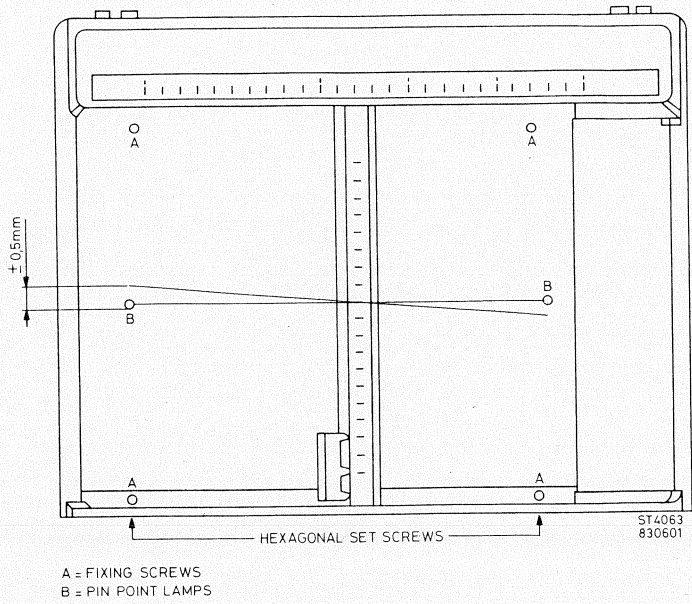


Fig. 17

Fig. 16-17 Adjusting the chart plate

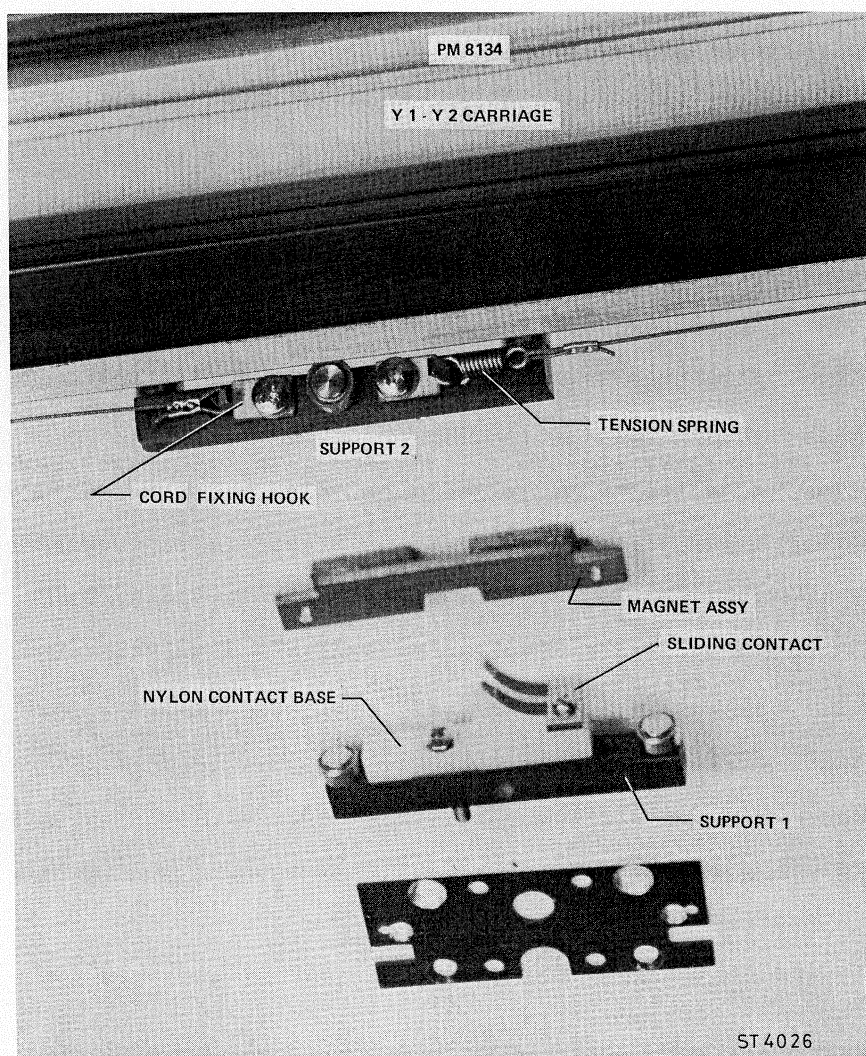


Fig. 18 Y1-Y2 carriages

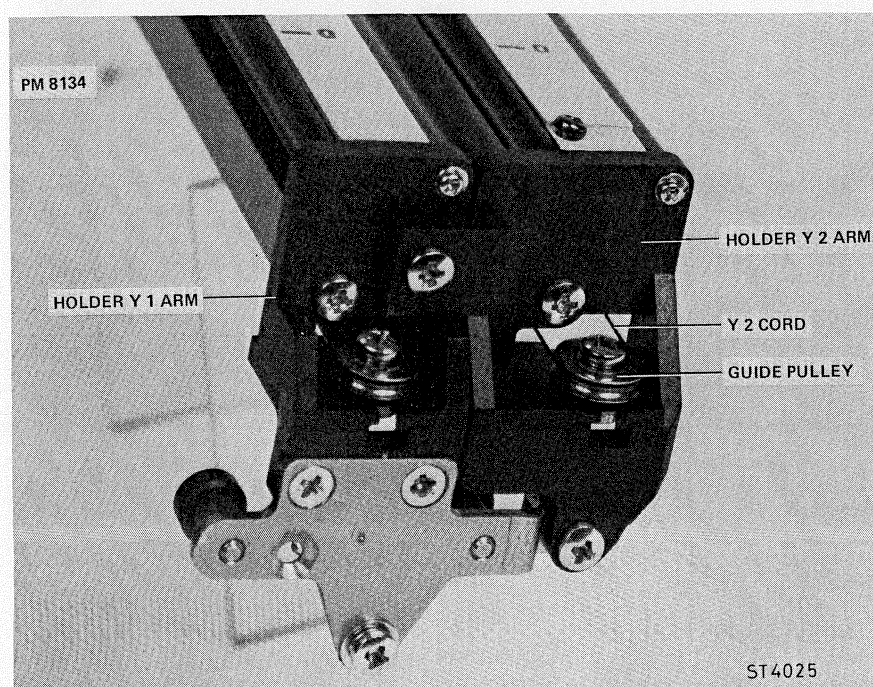


Fig.19 Holder Y1-Y2

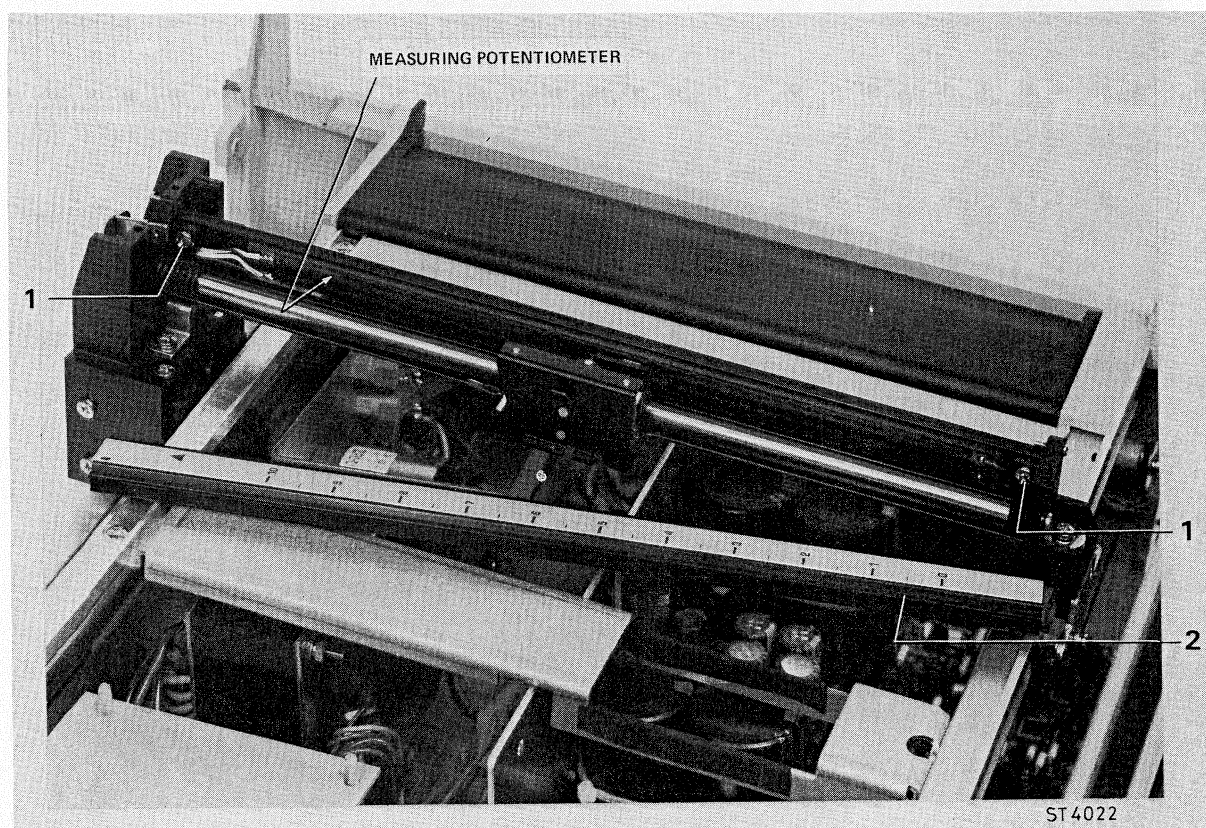


Fig. 20 Measuring potentiometer

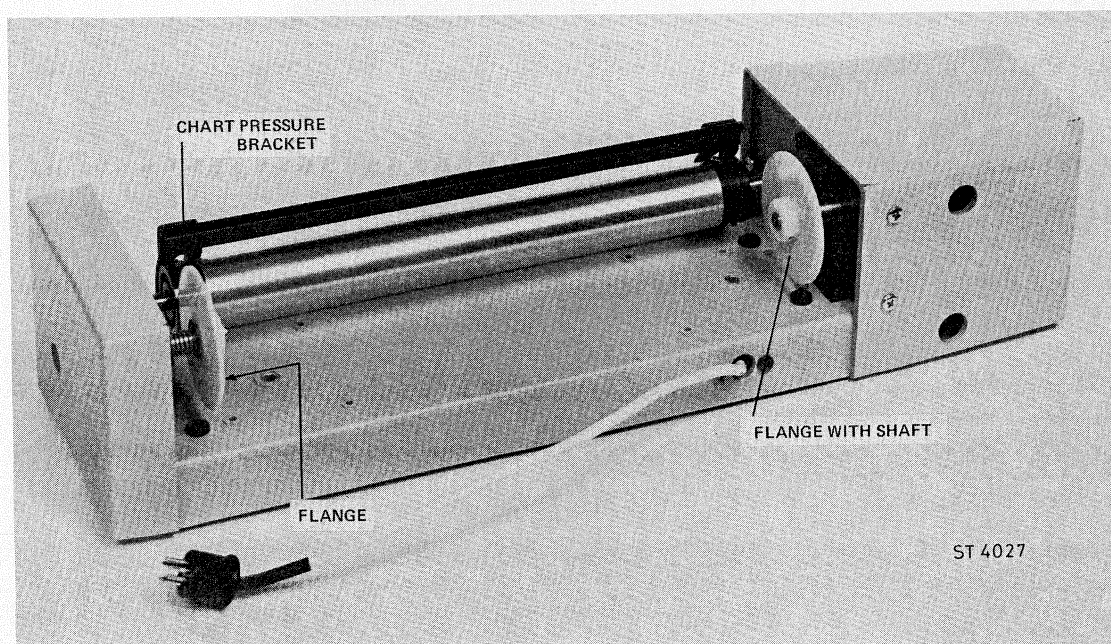


Fig. 21 Chart transport units

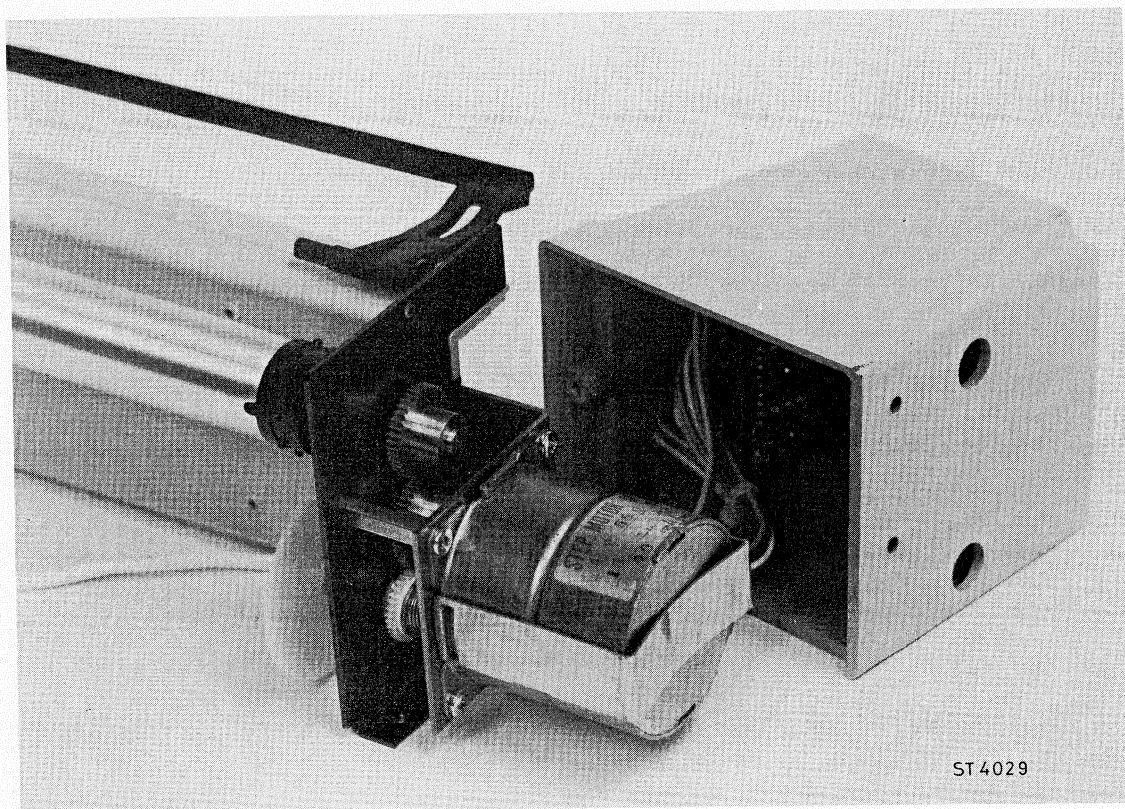


Fig. 22

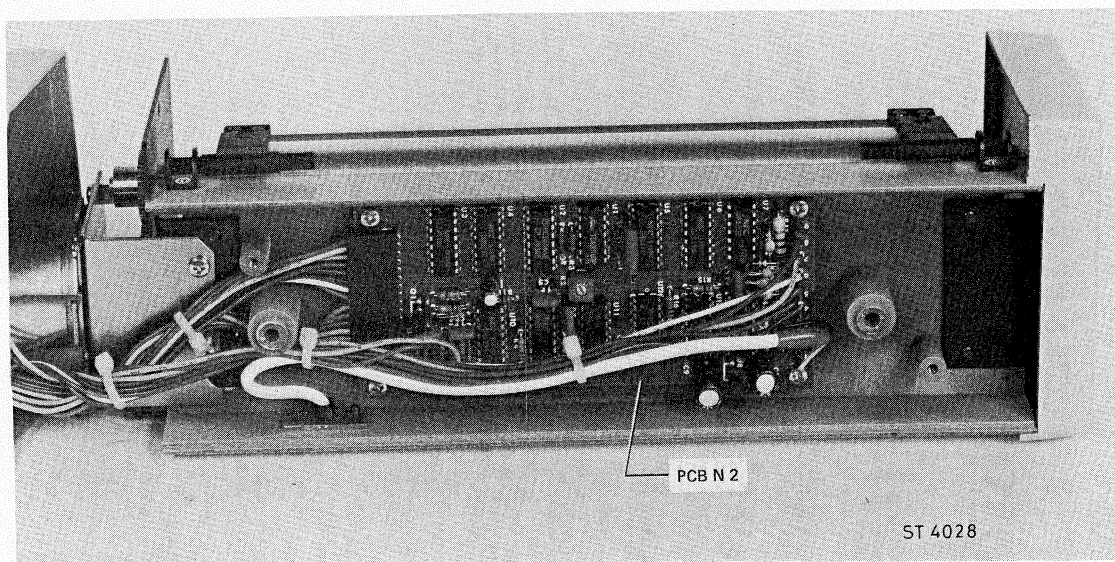


Fig. 23

Fig. 22-23 Chart transport units